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PSYCHOLOGY FOR BEGINNERS



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PSYCHOLOGY FOR BEGINNERS

BEING PART III. OF PHYSIOLOGY,
PUBLIC HEALTH AND PSYCHOLOGY

BY

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PREFACE

THE writer's "Physiology, Public Health, and Psychology," published in 1931, was intended for the use of students taking the Intermediate Examinations at Universities in India.

The sections dealing with Physiology and Public Health were subsequently published separately, by request, for the purposes of students preparing for examinations in which Psychology is not a required subject.

The third section of the book is now issued in separate form in the hope that it may be of service to readers who are beginning the study of Psychology.

The author takes this opportunity of acknowledging his indebtedness to the work of Professor Robert S. Woodworth, Ph.D., of Columbia University, author of "A Study of Mental Life," and Mr. Benjamin Dumville, M.A. (Lond.), F.C.P., formerly of the Educational Department of the London County Council, author of "Child Mind: An Introduction to Psychology for Teachers"; and to the Rev. Robert H. Jack, M.A. (Oxon), B.Sc. (Lond.), Rector of Wivenhoe, Essex, for his valuable contributions and suggestions.

CHARLES BANKS.

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PSYCHOLOGY

PSYCHOLOGY

THE term "psychology" is derived from two Greek words, *psyche*, soul; *logos*, reason. It has been defined as "the science of mind and mental operations and their analysis and classification." No subject, perhaps, has given rise to so much discussion and diversity of opinion as to whether psychology should be considered to be the science of the soul, mind, consciousness, or behaviour. Although much remains to be discovered before it can be regarded as an exact science, considerable knowledge has been acquired, by experiment and observation of facts established in this way, since the days of Plato, who located desire in the lower part of the body, anger in the heart, and reason in the brain. Even nowadays, persons who are of a spiteful disposition are said to be suffering from *spleen*. Referring to the present position of psychology in the realm of science, a critic in the *London Times* wrote: "In order to establish its claim to be one of the Natural Sciences, it must be able to differentiate its subject-matter. It must provide some hall-mark by which we may know the facts it deals with are as specifically mental and belong to a scheme of psychology, as physiological facts are specifically physiological and biological facts are specifically biological." The knowledge which has been acquired about physiological facts is much greater and more accurate than that about psychology. In many instances physiology and psychology are intimately associated. For example,

the sight, smell, or thought, even, of savoury food produces a flow of saliva and gastric juice; while anger and fear retard the flow and interfere with the activities of the stomach during digestion. These are psychological or mental effects.

Food in the mouth or stomach induces secretion of the digestive juices. This is a physiological process of an organic nature as distinguished from a mental effect. The various forms of psychology include differential, applied, and general psychology.

Differential psychology treats of the differences in the habits, conduct, and mode of life of individuals, the effect of hereditary tendencies and traits of character, and the effect of environment.

Applied psychology deals mainly with education and mental hygiene.

General psychology includes such mental operations as the acquirement of knowledge through the senses, perception, instincts, habits, imagination, association of ideas, memory, reasoning, interest and attention, and the will.

Psychology, moreover, includes in its range of study abnormal as well as normal individuals.

However much there may be in it to criticise, psychology is, admittedly, of the highest value to the educationist, the social reformer, and medical practitioner. So far as medical practitioners are concerned, whether they are conscious of the fact or not, much of the good effect obtained in the treatment of patients, more especially those suffering from functional, nervous, or imaginary ailments, is the result mainly of the psychological effect of inspiring them with confidence and giving them assurance. Even in organic diseases the same beneficial effect is often obtained in this way.

It would be impossible to study psychology to any

advantage without some knowledge of the nervous mechanism of the body, a description of which is therefore given in the following chapter, which may help towards a better understanding of what is said about various mental phenomena in later pages.

THE NERVOUS SYSTEM

THE nervous system consists of the brain, the spinal cord, and the nerves passing from them to different parts of the body.

The Brain is divided into the cerebrum, or great brain, and the cerebellum, or small brain.

The Cerebrum consists of two halves separated by a deep longitudinal fissure, called the right and left *cerebral hemispheres*. They are joined together at the bottom of the fissure, by a firm, dense nervous structure known as the *corpus callosum* (Lat. *corpus*, body; *callus*, hard skin), because of its consistency. This structure is the *great commissure*, or joint of the brain. It will be seen from the diagram (Fig. 69) that the surface of the cerebrum has numerous convolutions or folds all over it, with grooves lying between them.

The Cerebellum is situated beneath the cerebrum at the back of the skull. It also is divided into two halves by a fissure, and has a well-marked convoluted surface. It is attached above to the cerebrum by a band of nervous tissue, and below to a part of the brain called the *medulla* (Lat. *medulla*, marrow), from its appearance and consistency. The medulla is a continuation of the spinal cord into the skull cavity. The two halves of the cerebellum are united at the bottom of the fissure by a structure, composed of nerve fibres, known as the *pons* (Lat. a bridge) or *pons Varolii*.

Coverings of the Brain. These are three in number—viz., the *dura mater*, *arachnoid membrane*, and the *pia mater*.

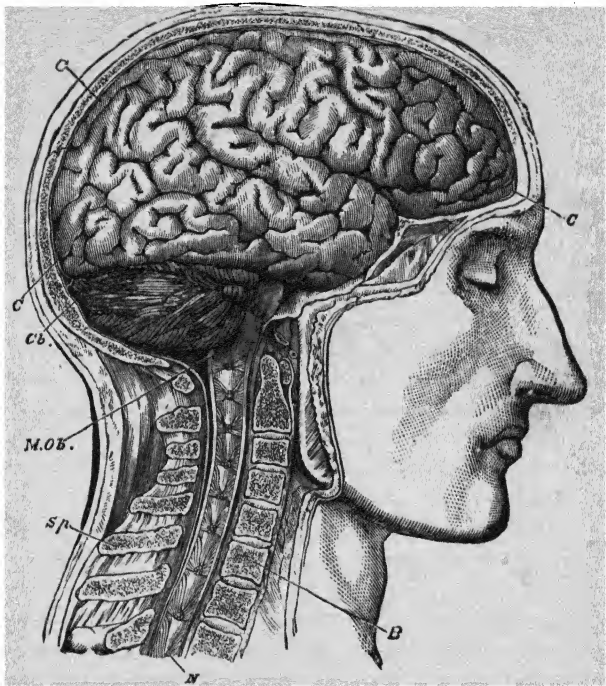


FIG. 69.—SIDE VIEW OF THE BRAIN AND UPPER PART OF THE SPINAL CORD.

C, The convoluted surface of the right cerebral hemisphere; *Cb.*, cerebellum; *M.Ob.*, medulla oblongata; *N*, spinal cord with spinal nerves; *B*, the bodies, and *Sp* the spines of the vertebræ.

The *dura mater* is a firm membranous structure consisting of two layers. The outer layer lines the inner surface of the skull. The inner layer supports the brain.

The *arachnoid membrane* (Gr. *arachne*, spider) is a thin,

transparent, and non-vascular structure like a spider's web. Hence its name. It forms a covering over the convolutions of the brain, but does not dip into the fissures. •

The *pia mater* is an extremely vascular membrane which covers the whole of the brain and dips into the convolutions and into the fissures. It also gives off coverings or sheaths to important structures inside the brain substance.

The collective name applied to the three coverings of the brain is *meninges* (Gr. *meninggos*, a membrane). Hence the term "meningitis" applied to inflammation of the coverings.

Cortex of the Brain (Lat. *cortex*, bark) is the outer grey layer of the brain substance. It is composed of five layers of nerve cells and nerve fibres, the supporting structure of which is called *neuroglia*, which has been described as "the peculiar ground substance in which are embedded the true nervous constituents of the brain and spinal cord" (Gray). The undermost layer of the cortex is closely connected with the white matter of the brain through which three sets of nerves pass. These are as follow :

1. *Afferent* or sensory nerves, which convey impulses to the cortex, and *efferent* or motor nerves, which convey impulses from the cortex to muscles and other parts of the body.

2. Nerves which link up different parts of the cortex, and form what is called the *Association System*. When nerves link up convolutions of the brain situated near each other, they form what are called *short association tracts*. When lobes of the brain are linked up, they form *long association tracts*. What are known as the *associate l areas* of the brain will be referred to further on.

3. Other nerves form bands connecting portions of the two halves of the brain together, forming what is called the commissural system—*e.g.*, the p. s Varolii previously mentioned.

Cranial Nerves are those which proceed from different parts of the brain and pass through openings in the skull to supply organs in different parts of the body. There are twelve pairs, some of which are the nerves of the special senses of touch, smell, sight, taste, and hearing. Others are for regulating the movements of the eyeball, tongue, etc. The *pneumogastric* nerve (Gr. *pneuma*, breath; *gaster*, the belly) is an important cranial nerve which contains both *sensory* and *motor* nerve fibres. It supplies both kinds to the organs of the voice and motor branches to the

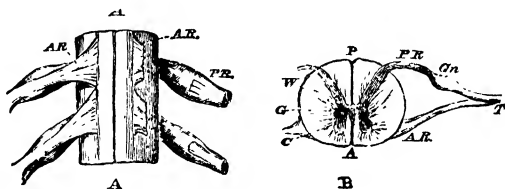


FIG. 70.—A, FRONT VIEW OF A PORTION OF THE SPINAL CORD. On the left side of the cord the anterior roots, *AR*, are cut to show the posterior roots, *PR*.

B, CROSS-SECTION OF THE CORD.

A, Anterior fissure; *P*, posterior fissure; *G*, central canal; *C*, grey matter; *W*, white matter; *AR*, anterior root; *PR*, posterior root; *Gn*, ganglion of posterior root; *T*, trunk of a spinal nerve.

pharynx, gullet, stomach, and heart. Because of its wide distribution, it is sometimes called the *vagus* nerve (Lat. *vagus*, wandering).

The Spinal Cord is continuous with the brain, and passes downwards, in the vertebral canal, to the lower part of the vertebral column. It is about 18 inches long and $\frac{1}{2}$ inch thick. It has a longitudinal fissure in front, and another behind. They almost divide the cord into two halves. The dark shaded portion, seen in the cross-section in the diagram, represents what is known as the *grey matter*

and the unshaded portion what is known as the *white matter* of the cord (Fig. 70).

The grey matter is so distributed in the two halves of the cord as to resemble the letter **H**. The front projecting portions of the grey matter are called the *anterior cornua* or *horns*, and those behind are called the *posterior horns*. The two halves are united in the middle by a narrow band which separates the two fissures. A small duct passes in the centre of the band throughout the entire length of the cord.

Coverings of the Spinal Cord. These are similar to those of the brain. The *dura mater* lines the inner surface of the spinal canal, to which it is loosely attached by a fine intervening membrane richly supplied with small blood-vessels. The *arachnoid membrane* is separated from the *dura mater* by a space containing fluid. This space, at its lower part, also contains the end portion of the spinal cord and long nerve roots given off from it. The cord and the nerves form what is called the *cauda equina* (Lat. *cauda*, tail; *equinus*, a horse). The *pia mater* is closely adherent to the spinal cord, and portions of it pass into the substance of the cord and form sheaths for some structures in it.

Between the *pia mater* and the *arachnoid membrane* is a large space containing *cerebro-spinal fluid*, the examination of which is of the greatest importance in certain diseases of the brain and spinal cord, such as cerebro-spinal meningitis.

Spinal Nerves. Thirty-one pairs of spinal nerves are given off from the spinal cord through openings on either side of the spinal column. Each nerve has an anterior and a posterior *root*. Each posterior root has a small swelling on it called a *ganglion* or nerve centre composed of a mass of *sensory* nerve fibres (see Fig. 70).

The *anterior roots* have no *ganglia*. They contain

motor nerve fibres which have their origin in large motor nerve cells in the anterior horns of the grey matter of the spinal cord.

Structure of Nerves. Nerves are composed of bundles of filamentous fibres, the finest of which may not be more than $\frac{1}{1000}$ part of an inch in thickness. The *axon*, or central core, is surrounded in motor nerves throughout their entire length by two coverings. The inner covering consists of a fatty-like substance called *myelin* (Gr. *myelos*, marrow). This covering is called the *white sheath*, as distinguished from the outer covering called the *grey sheath*. "The white sheath probably serves to protect, nourish, and insulate the axon" (Roberts). Insulation, in this application, means that nerve currents passing through the axons to their nerve centres cannot be diverted from their course. It should be noted that it is the white sheath of the nerves which form the white matter of the brain and spinal cord. The grey matter, on the other hand, consists mainly of nerves and nerve cells which have *no white sheath*. This explains the difference in the amount of grey and white substance in the brain and spinal cord and in different parts of these structures.

The greater the number of nerves with white sheaths passing through any part of the brain or spinal cord, the greater will be the amount of white matter; and the greater the number without white sheaths, the greater will be the amount of grey matter.

In the foregoing pages, reference has been made to nerve cells, nerve centres, and ganglia in the description of the cortex of the brain and of the spinal cord and spinal nerves.

Before proceeding further, a definition of the terms may make what is contained in later chapters more easily understood.

Nerve cells are nucleated masses of protoplasm which

enter into the formation of any part of the nervous system, and all nerves are composed of them.

Nerve centres are collections of nerve cells composed of grey nervous substance. They are sometimes spoken of



FIG. 71.—A NERVE CELL FROM THE CEREBELLUM. (LUCIANI.)

as *neurones*. But a neurone, as is explained below, consists not only of a nerve centre, but of nerve branches connected with them (Fig. 71).

A *ganglion* is an enlargement in the course of a nerve

forming a special centre of nervous action or influence, and is composed of masses of grey nervous matter.

Neurones. A neurone consists of a nerve centre and all the nerve branches associated with it (Fig. 72).

Neurones may have one nerve branch only or two or more branches, and have been classified, for this reason.



FIG. 72.—DIFFERENT TYPES OF NERVE CELLS.

as unipolar, bipolar, and multipolar nerve centres respectively. The main nerve branch is called the *axon* or *axis-cylinder process*, which is the core or central portion of nerves. The branches from the axon are called *dendrons* or *dendrites* (Gr. *dendron*, a tree), because of their tree-like appearance. All the branches, of each individual neurone, are, directly

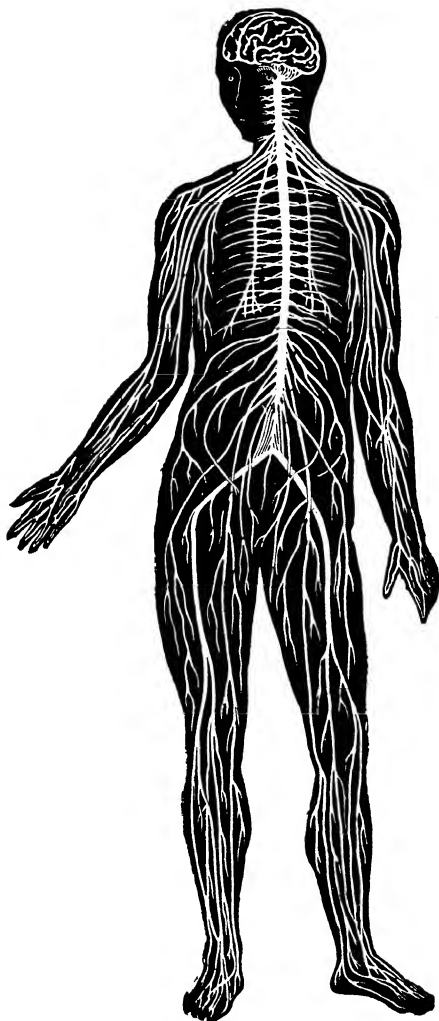


FIG. 73.—DIAGRAM OF THE NERVOUS SYSTEM, SHOWING THE BRAIN SPINAL CORD, AND NERVES.

or indirectly, connected with each other, as are, also, the nerve centres. The whole nervous system is composed of numberless neurones. "It is possible that their office is not merely to transmit the disturbance arriving at them, but to send it on with increased energy, acting like a battery relay in a telegraphic circuit" (Starling).

The axons of nerves may be very short or of great length; but no matter what their length may be, all of them are continuous from the nerve centres in which they originate to their termination, and give off branches in their course. The longest axon, in the body, is that of the *sciatic* nerve which has its origin in a plexus of nerves in the sacral bone region and passes through the pelvic cavity down the back of the leg to the great toe. (See Fig. 73, which is introduced here to give a general idea of the distribution of the nerves throughout the body.)

THE SYMPATHETIC NERVOUS SYSTEM

The Sympathetic Nervous System consists of two chains of ganglia, nerves and plexuses of nerves, situated one on either side of the spinal column and along which they travel, in a downward direction, through the neck, chest, and abdomen, in close relationship with the aorta. Each chain begins its course in a ganglion situated at the base of the skull and terminates in a ganglion in the coccyx. Other ganglia are located in the heart, lungs, kidney, and spleen. Plexuses of nerves and ganglia exist also in almost every part of the walls of the alimentary canal. Further, there are ganglia in the salivary glands, the internal ear, and in the orbital cavities. The ganglia of the sympathetic nervous system are considered to be, to some extent, independent of the central nervous system—that is, of the brain and spinal cord, with both of which, however, the

sympathetic ganglia and their nerve branches are linked up. The sympathetic nerves have no white sheath. They are continuations of the sensory nerves, which pass from the spinal cord through the openings in the vertebrae nearest to which the sympathetic ganglia are situated. The chief functions of the sympathetic nervous system are to regulate the contraction and dilatation of the blood-vessels, the action of the stomach and other parts of the digestive canal, and to some extent other organs in the abdomen. It also regulates the action of the heart and the secretory glands, especially the salivary glands, and helps to maintain the heat of the body. The actions of the pupil of the eye, the urinary and genital organs, and the skin are also controlled by the sympathetic nervous system (Fig. 74).

The Sympathetic Ganglia and their Connection with the Cranial and Spinal Nerves. Sensory or afferent nerves (Lat. *ad*, to; *ferre*, to carry) transmit impulses from different parts of the body to ganglia in the spinal cord and brain. Motor or efferent nerves (Lat. *ex*, out; *ferre*, to carry) transmit impulses from ganglia in the brain and spinal cord mainly to involuntary muscles and secretory glands. The sensory nerves, in their course to the spinal cord and brain, pass through one or other of the ganglia in the sympathetic chain. The motor nerves, in their course from the brain and spinal cord, also travel, by way of the sympathetic ganglia, to their terminations. The sensory nerves induce impulses in the motor nerves, which in turn induce muscular action in the heart, digestive canal, etc., and glandular secretion. This is known as *reflex action*, which is considered more fully later. In concluding this chapter, it may be mentioned that some nerves are entirely sensory, while others are entirely motor. The majority of them, however, contain both sensory and motor nerve fibres.

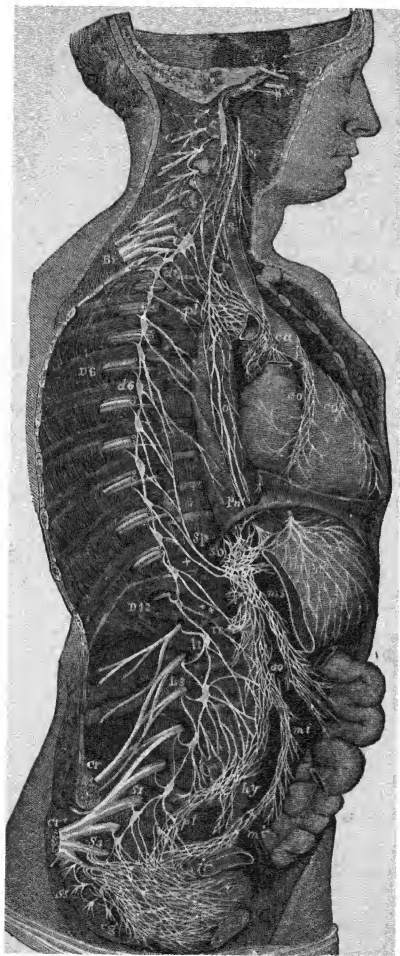


FIG. 74.—THE SYMPATHETIC NERVE CHAIN OF THE RIGHT SIDE, SHOWING BRANCHES GIVEN OFF TO VARIOUS INTERNAL ORGANS AND CONNECTIONS WITH THE SPINAL NERVES.

(From Furneaux's "Human Physiology." By permission of Messrs. Longmans, Green and Co., Ltd.)

Their functions are the adjustment or regulation of the activities of the various organs of the body and maintaining them a healthy state. They also influence growth and development.

STIMULUS AND RESPONSE

Stimulus and Response. *Stimulus* may be defined as an agent producing reaction in any irritable tissue or bodily organ, and *response* as the reflected action or movement caused by a stimulus. The length of time taken in making response to different kinds of stimuli can be measured by an instrument called a *chronoscope* (Gr. *chronos*, time; *skopein*, to look at). It has been demonstrated, in this way, that the response to sound or touch takes about three twenty-fifths of a second, and of light three-fourteenths of a second. The one-tenth of a second is regarded as the shortest possible time in which, under the most favourable conditions, response can be made to any stimulus. Response to an order such as "Ready! present! fire!" or the application of the brakes to a motor-car when a policeman regulating street traffic puts his hand up are examples of what are called "*simple reaction*." Decision, or making up one's mind as to how to cross a road with the greatest chance of getting to the opposite side safely, is an example of what is termed "*choice reaction*." Test experiments have been made, by selecting colours to be named, by the multiplication or addition of figures, mental arithmetic, and in other ways, to ascertain how long it takes to make a response. This is called "*association re-reaction*."

In this reaction several seconds, or even minutes, may be occupied in responding, or no response at all may be made. All these are sensory reactions.

Reflex Actions are movements which take place in muscles

independently of the will. For their production a sensory nerve, a nerve centre, and a motor nerve are necessary. This is known as a *reflex arc* (Fig. 75).

In the diagram below the stimulus is represented as proceeding from the skin through a sensory nerve to a nerve centre in the spinal cord, and thence to the brain, from which an impulse is conveyed through a motor nerve to special sensory nerve endings in a muscle. Other examples of reflex action are as follow:

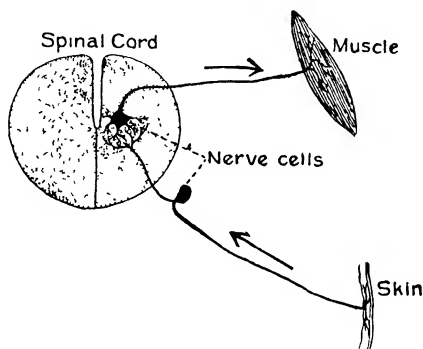


FIG. 75.—DIAGRAM OF A REFLEX ARC, SHOWING THE DIRECTION IN WHICH THE MESSAGE TRAVELS FROM THE SKIN TO THE SPINAL CORD, AND FROM THE SPINAL CORD TO THE MUSCLE.

1. If a speck of dust or other foreign substance gets into the eye, the eyelids immediately close and a flow of tears takes place. So rapid is this protective response that foreign bodies may not get further than the eyelids.

2. If a strong light be held in front of the eye, the pupil at once contracts to protect the inner delicate structures.

3. If one happens to tread, barefooted, on a piece of hot charcoal, or gets a needle into the foot, the leg is promptly flexed and the foot raised, and in this way serious injury

which might result from continued contact and pressure is prevented.

4. If a gentle tap be given to the tendinous structure which encloses the knee-cap, either above or below the knee-cap, so long as no restraint is applied, the leg is immediately jerked forward. The time occupied in making this response is said to be only about one thirty-third of a second and to be the quickest of all responses.

5. Coughing and sneezing are further examples.

The reflexes mentioned are known as the *lid reflex*, *pupil reflex*, *flexion reflex*, *patellar reflex*, and *protective reflexes*. Besides these, there are what are called *internal reflexes*. Their functions are to regulate involuntary muscular movements, such as those of the stomach and intestine, the dilatation and contraction of arteries through nerve influence on the muscular layers in their walls, and glandular secretion such as saliva, gastric and other intestinal juices. There are, also, what are called *inhibitory reflexes*, which check muscular movements. Breathing, for example, is checked, when one plunges into excessively cold water, through the respiratory muscles ceasing to act, or the heart may be reflexly inhibited in its action by a severe blow over the pit of the stomach. Sudden death, even, is not infrequently due to inhibitory reflex action. Internal reflexes are inborn and essential to existence. The habit of responding to stimuli may be acquired. We may respond to sounds, for example, without actually being aware of the fact, as when the mind is concentrated, say, on trying to solve a difficult mathematical problem, or when studying any subject that requires great mental effort to grasp the meaning of—as, for example, psychology.

Habit Responses are such as are acquired during life. To learn, *e.g.*, to play the violin or any other musical instrument requires long practice and continuous mental effort

But in course of time playing becomes automatic, or, in other words, it involves no conscious effort. Habit responses are innumerable.

Effect of Damage to Reflex Arcs. Owing to the interdependence of nerve centres and sensory and motor nerves in a reflex arc, any break in its continuity involves loss of function. And as some reflex arcs have a long range, the loss of function may be very widely distributed. The effects produced by such occurrences are loss of the power of movement, loss of sensation, and inability of the bodily organs to perform their natural functions in a normal way. This is what is termed *paralysis*. Injuries and diseases of the brain and spinal cord affecting the important nerve ganglia situated in these organs are often the cause of complete or incomplete paralysis of movement and sensation and of bodily organs. The degree and extent of the paralysis depend upon the nature and severity of the lesion and the part of the brain or spinal cord affected.

THE PHYSIOLOGICAL BASIS OF SENSATION

Sensation is the perception of impressions made upon the mind by stimuli conveyed through sensory nerves to nerve centres in the cortex of the brain. Stimuli may be conveyed through the skin, eye, ear, or nose, and are classified as cutaneous, light, sound waves, and chemical stimuli. Each kind of sensory nerve conveys one sensation only. This is called the "*law of specific irritability*" or "Müller's law." Just as muscles become fatigued through excessive use, so do the sense organs if over-stimulated. And if any kind of stimulus is kept applied too long, the perception of the sensation produced is lessened. The sensation, on the other hand, may be increased by the application of different kinds of stimuli one after the other. "Hot water, for

instance, feels hotter to the hand after the application of cold " (Roberts). The location of some of the sensory nerve centres in the brain is not known. It is, however, known that the nerve-centre of sight is situated in the *occipital lobe* of the brain at the back of the skull, and those of hearing, taste, and smell in the *temporal lobe* at the side of the skull. Those of pressure, or touch, and temperature are located in the brain cortex.

Very little is known about the physiological basis of *pain*. But, so far as the skin is concerned, it is believed that " there exists a special set of sensory nerve fibres which have a specific energy for pain " (Howell).

The sensations of *hunger* and *thirst* are experienced internally. The sensation of appetite has been thought to be due to sensory nerve fibres either in the muscular layers of the stomach wall or in the lining membrane of the stomach. But, as loss of appetite occurs in diseases of the lining membrane of the stomach, it is generally believed that sensory nerves in that membrane not only regulate the appetite, but also induce, in some way or other, the feeling of hunger when the stomach is empty. The sensation of *thirst* is located in the back of the tongue and the lining membrane of the pharynx, which derive sensory nerve branches from one of the cranial nerves—the glosso-pharyngeal nerve (Gr. *glossa*, the tongue; and *pharynx*). The sensation of thirst is induced through loss of water, which seems to stimulate the sensory nerves.

" This is one reason for assuming the existence of sensory nerve organs." A further reason for this assumption is the fact that " local drying in this region, from dry or salty food, or dry and dusty air, produces a sensation of thirst that may be appeased by moistening the lining membrane with a small amount of water not in itself sufficient to relieve a genuine water need of the body " (Howell).

The Skin Senses. Touch, cold, warmth, and pain are considered to be the only primary senses, but some of them may be mixed. It has been found by tests with fine hairs and sharp and blunt-pointed instruments, either above or below the temperature of the blood, that the skin contains *touch, cold, warm, and pain spots*, each of which, when stimulated, produces one sensation only. The sense of touch is located mainly, in the tactile corpuscles, at the ends of fine sensory nerves in the papillæ of the skin. The papillæ form a series of ridges all over the skin, and can be seen with the aid of a magnifying glass. "And although there may be as many as 2,000 papillæ to each square inch of skin, each tiny nerve communicates with the brain separately as telegraph lines unite at a terminus" (Bernstein). The epidermis or outer layer of the skin is a non-sensitive structure.

The sense of touch varies in degree of intensity. It is highly developed in the points of the fingers. By touch we can tell variations in temperature, whether things are coarse or fine, rough or smooth, hard or soft, and so forth. Some parts of the skin which are extremely sensitive to touch are not so sensitive to heat, as, for example, the palmar surface of the fingers. The parts most sensitive to heat are the eyelids, elbows, and cheeks.

The touch spots are situated at the roots of the hairs, which are supplied with a network of fine sensory nerves which are extremely sensitive and responsive when the hairs are subjected to the most delicate pressure.

Pain is induced when anything harmful touches the skin, and by motor response the part affected is protected either by the speedy removal of the cause of the pain or the withdrawal of, for example, the foot or hand if any hot substance is touched. Pain is thus a *protective sensation*. The sensory nerves of pain are an example of what are called *naked*

nerves. That is to say, their axons have neither a white nor a grey sheath covering them.

The sense of temperature is believed to be due to *end-bulbs*, which consist of coils of axons of sensory nerve-fibres in the skin. The nerve-bulbs are supposed to be the sense-organs of cold and warmth. They are also supposed to be the sense-organs of touch in the skin of the palms of the hand and the soles of the feet, and partly of touch in the hairs. The sensations of the skin used to be included under one head—the “sense of touch.” They are now classified as *pressure* or *touch sense*, *warmth sense*, *cold sense*, and *pain sense* respectively.

The nerve-centres of temperature, pressure, or touch and fine muscular sensations are situated in the cortex of the cerebrum.

The Sense of Vision. All visual sensory impressions are due to stimuli, of different kinds, in the form of waves of light passing through the eye and falling on the retina, which is its innermost covering. The retina is composed of the following structures—viz. (1) A pigmented layer; (2) receptive nerve-cells called *rods* and *cones* respectively; (3) two layers of neurones; and (4) an expansion of nerve-fibres from the optic nerve (Fig. 76).

Stimuli reaching the retina are conveyed from it through the axons in the optic nerve-fibres to the nerve-centre of vision, which is situated in the occipital lobe of the brain, at the back part of the skull, where visual sensations are analysed and interpreted. The sensations are then transmitted outwards to the retina, on which objects looked at are depicted in the form of images. The recognition of the objects is learned from experience. That is to say, we become conscious of the differences in the sensations produced by the stimulation of different parts of the retina, each portion of which is assumed to be connected with a

different portion of the cortex of the lobe of the brain in which the visual nerve-centre is located.

Owing to some defect in one part of the cortex of the visual nerve-centre area, the perception of words may be rendered impossible. This is known as "*word-blindness*,"

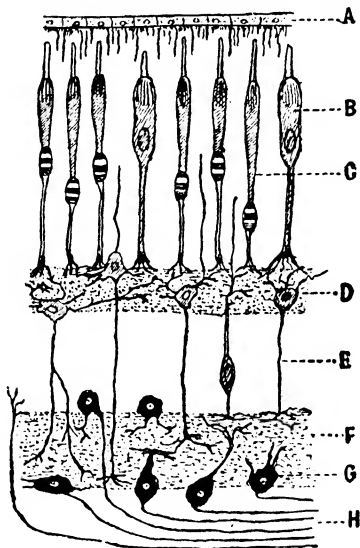


FIG. 76.—THE RETINA SECTION, HIGHLY MAGNIFIED, SHOWING ITS VARIOUS LAYERS.

A, Layer of pigment cells ; B, C, of rods and cones ; D, E, F, of small nerve cells and their processes ; G, of large nerve (ganglion) cells ; H, of nerve fibres passing from ganglion cells to optic nerve. (After Stohr.)

(From Drummond's "Physiology." Edward Arnold.)

or it may be that objects are not recognisable because of defect in some other part of the cortex. Persons suffering from this defect are said to be "*object-blind*." It is believed that the function of the cones of the retina is to perceive colours and differentiate them and that the rods respond

only to the stimuli of light and darkness. *Colour-blindness* is considered to be due to defects in the cones, and what is known as *night-blindness* to some failure in the functioning of the rods. Changes in the eye which prevent waves of light passing freely to the retina, as, *e.g.*, cataract, which is an opacity of the crystalline lens, may impair vision or completely exclude light and cause blindness. And no impressions of any kind would be conveyed to the visual nerve centre in the brain if the optic nerve were severed or destroyed by disease, or if the nerve centre itself were destroyed.

The Sense of Hearing. Sound-waves, on entering the ear, pass to a structure, in the cochlea, known as "*Corti's organ*." The sounds on reaching this organ are believed to be analysed by the strands of fibrous tissue in the basilar membrane, which forms the base of *Corti's tunnel*. It is stated that there are no less than 20,000 fibres in the membrane which, like the strings of a musical instrument, vibrate when sounds strike against them.

"The combination of the fibres, excited by the sounds, are believed to differ with each tone or combination of tones" (Starling). In order to hear a note the rate of vibration is 16,000 to 40,000 vibrations per second. But it is said that in most people no sound is produced above or below 30,000 vibrations per second. "Two sounds, following one another, are said to be perceived as distinct if the interval between is not less than $\frac{1}{500}$ of a second" (Exner). Although the organ of Corti is believed to analyse sounds, the whole mechanism of hearing is under the control of the auditory sensory nerve-centre, which is said to be located in the temporal lobe of the brain in front of the visual nerve-centre area. It is thought that different parts of the cortex in the auditory sensory-area deal with different

kinds of auditory perception, such as word-deafness and music-deafness. With reference to this Woodworth says: "At least, we sometimes find individuals who, as a result of injury or disease affecting this general region, are unable any longer to follow and appreciate music. They cannot 'catch the tune' any longer, though they may have been fine musicians before this portion of their cortex was destroyed."

The Mechanism of Hearing. Sound-waves entering the meatus or opening of the external ear strike against the tympanic or drum-membrane. In doing so they are converted into vibratory movements which are conducted through the three small bones in the *air-filled* tympanum or middle ear to the fenestra ovalis, which is enclosed by a membrane to which the foot of the innermost bone—the stapes or stirrup-bone—is attached. The vibrations push the membrane *inwards* towards the vestibule or entrance of the internal ear which is filled with fluid—the perilymph. The vibrations are then continued in the perilymph in the semicircular canals, and in the scala vestibuli to the apex of the cochlea and, downwards, in the scala tympani to the fenestra rotunda, which is also enclosed by a membrane separating the cochlea from the middle ear. This membrane is pushed *outwards* towards the middle ear by the swaying movements in the perilymph. The movements in this continuous column of perilymph are reflected to the *endolymph* contained in the membranous labyrinth of the cochlea and excite the minutest nerve-fibres of the cochlear branch of the auditory nerve which are supposed to terminate in the inner and outer highly sensitive nervous hair-cells of the organ of Corti. From these hair-cells the impressions received pass to the auditory sensory-area in the brain through the fibres of the auditory nerve.

The Sense of Smell. Owing to the plentiful supply of minute sensory nerve-fibres to its lining membrane the nose is highly sensitive and responsive to the smallest particles of substances of an odoriferous kind. Such particles are given off from gases, liquids, and solids, but the most penetrating odours are derived from gases. The sense of smell is situated in the upper part of the nose in a structure called the *olfactory organ* (Lat. *olfactûre*, to smell; *olêre*, to smell; *facêre*, to make). This organ consists of cells with tufts of hair-like processes connected with sensory nerve-fibres, the axons of which, like those of the sensory nerve-fibres of pain, have no coverings. Their highly sensitive nature is due to this cause.

When the nasal passages, which are moist normally, become dry the sense of smell is diminished. It varies in degree in different people, and is highly developed in some of the lower animals. In order to detect any very faint odour it is necessary to sniff the air several times in quick succession so as to bring the odoriferous particles into intimate contact with the fine endings of the olfactory nerve. The sense of smell is intimately associated with that of taste. It is almost impossible to taste even strongly flavoured substances when the nose is held.

Owing to the intricate structure of the nasal passages, and the secluded situation of the sensory nerve-fibres, it has been found difficult to determine by tests the exact effect on them of different kinds of stimuli. It is believed, however, that there are only six elementary odours—viz.:

1. Spicy, found in pepper, cloves, nutmeg, etc.
2. Flowery, found in heliotrope, etc.
3. Fruity, found in apples, orange oil, vinegar, etc.
4. Resinous, found in turpentine, pine needles, etc.
5. Foul, found in sulphuretted hydrogen, etc.
6. Scorched, found in tarry substances.

Compound odours may be formed by some of the elementary odours as, *e.g.*, that of roasted coffee, which is a compound of the resinous and scorched, and peppermint, which is a compound of fruity and spicy odours (Woodworth).

The Sense of Taste is located in the taste-bodies or taste-bulbs of the papillæ of the tongue in which the sensory nerve-fibres terminate. Some taste-bodies are also found in the soft palate, epiglottis, and vocal cords. Each papilla has, in its centre, an elongated cell with a hair-like structure attached to it which passes through a small opening to the surface of the tongue. These cells are considered to be the sensory cells of taste. When stimulated by any savoury substance coming into contact with them impulses are conveyed to taste nerve-fibre connected with and surrounding the cells. The impulses are then conveyed through the main branches of the nerves to the nerve-centre or centres in the cerebrum, concerned with the sense of taste. The origin of the nerve-fibres of taste in the brain is uncertain. It is known, however, that the front two-thirds of the tongue derive sensory nerve-branches from the *lingual nerve* (a branch of the facial nerve), and that the back one-third of the tongue gets sensory nerve-branches from the *glosso-pharyngeal nerve*. The *facial nerve*, besides supplying a sensory nerve (lingual) to the tongue, also supplies motor-nerve branches to the muscles of mastication. The *glosso-pharyngeal nerve*, besides giving sensory branches to the base of the tongue and pharynx, also supplies them with motor-nerve branches. These two nerves are mentioned here as being good examples of what are called mixed nerves or nerves which contain both sensory and motor nerve-fibres.

Association of Taste with Other Senses. Taste is intimately associated with other sensations in the mouth—viz., touch, warmth, cold, and pain. Softness and

hardness or smoothness and roughness of food or other substances are examples of the sense of touch in the mouth and tongue. The sensations of warmth, cold, and pain are, through experience known to everyone. Leaving aside these associated sensations, tastes have been classified as sweet, sour, bitter, and saltish, and are called the elementary or primary tastes. Mixtures of the primary tastes are described as *compounded tastes*. Sweet taste is located in the papillæ at the tip, sour taste in the edges, bitter taste at the back, and saltish taste both in the tip and sides of the tongue.

So delicate is the sense of taste that the presence of one drop of sulphuric acid in 1,000 drops of water can be recognised.

The sense of taste is excited only when substances are well dissolved and come into close contact with the sensory cells in the papillæ, and neither sugar nor salt can be tasted when the tongue is dry. One of the functions of the saliva is to dissolve substances of the kind contained in food.

“The flavour of food consists largely of odour. Food in the mouth stimulates the sense of smell along with that of taste, the odour of food reaching the *olfactory organ* by way of the throat and the rear passage to the nose. If the nose is held tightly so as to prevent all circulation of air through it, most of the ‘tastes’ of food vanish; coffee and quinine then taste alike, the only *taste* of each being bitter, and apple-juice cannot be distinguished from onion-juice” (Woodworth).

THE ACQUIREMENT OF KNOWLEDGE THROUGH THE SENSES

WHILE discussing the physiological basis of sensation we learned that all sensations are due to stimulus and response through nerves and nerve-centres. Reference was made to what are called the *associated areas* of the cortex of the brain, which are sometimes spoken of as the *silent areas* because, as has been shown by experiment, they make no

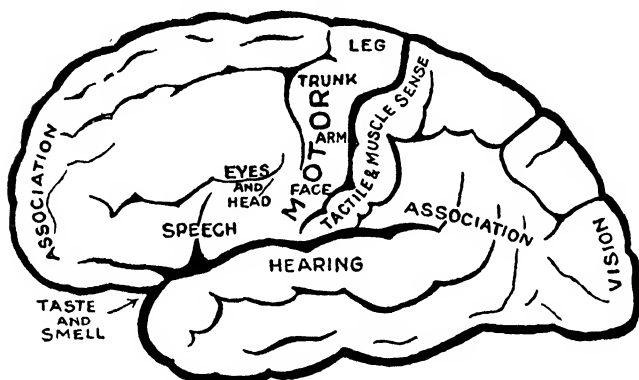


FIG. 77.—DIAGRAM SHOWING THE LOCALISATION OF FUNCTION IN THE CORTEX OF LEFT CEREBRAL HEMISPHERE.

(From Bainbridge and Menzie's "Essentials of Physiology." By permission of Messrs. Longmans, Green and Co., Ltd.)

response to electric stimuli applied to them. It is in these areas that the higher mental activities take place. "They are," as Howell observes, "the regions in which the different impressions are synthetised into complex perceptions or concepts." In other words, they are the areas of the cortex of the brain where the sense impressions are combined to form evidence of existing objects or facts, and also to form images or ideas in the mind regarding them. Diagram

(Fig. 77) illustrates the large extent of the associated areas as compared with the motor and sensory-organ nerve areas.

Bolton, in his classification of the layers of gray nervous matter of the *cerebral* cortex, has observed that, in the frontal and parietal associated areas, the outer layer is very thick, and that, in the visual associated area, the outer layer, which is concerned with the effect of visual impressions on the mind (visuo-psychic), is nearly twice as thick as that in the associated area concerned with the sensations produced when objects are looked at (visuo-sensory). Since it is through the sense of vision that so much of our knowledge is acquired, the relatively greater development of the cortex in the visual associated area will be readily understood.

The outer layer of the cortex is stated to be the last to develop and the first to be affected by disease; that the degree of its development is increased as the animal scale is developed; that its thickness develops with the mental capacity of the individual; that if it is congenitally deficient *amentia*—absence of intellect—is the result; and that degenerative changes are associated with *dementias*, *i.e.*, insanity. Regarding this Bolton has observed “in persons who are insane wasting of the cortex which takes place depends upon the degree of the mental derangement.”

The development of the cortex depends largely on the extent to which the higher faculties of the mind are exercised. Neglect in this respect leads to wasting of the cortex and impairment of the intellect in consequence. Other factors which induce wasting of the cortex are alcoholic excess and senility, in which the most marked features are loss of memory, inability to concentrate or put forth mental effort, and loss of muscular power.

All normal children, at birth, possess the senses of hearing, sight, skin sensations, etc., and certain inborn reactions. They can make muscular movements though they cannot

walk, and let their vocal organs be heard though they cannot speak. As the body develops, so also does the nervous system, culminating in the completion of nervous reflex arcs previously described (p. 249), and, in due course, children learn, by imitation and through experience, to walk when their muscles are sufficiently developed, and to combine sounds into words to form speech and get to know the meaning of the words used. Referring to the brain of the child, Professor Sir Arthur Keith, some years ago, in one of his lectures on *Craniology* at the Royal College of Surgeons, London, stated that a child has to grow nearly all its life-time's brain before it is four years of age, and added: "It is born with about 30 per cent. of its total; within a year this has increased to 50 per cent.; by the fourth year it is 80 per cent., and when the child goes to school it has almost its entire mental outfit, though the brain continues growing very slowly until the nineteenth or twentieth year. Contrariwise, the chimpanzee and the gorilla are born with brains as large as that of the human infant, but they scarcely grow at all after birth."

The associated areas are linked up with the sensory nerves by *associated nerve-tracts*, through the combined action of which, and of the sensory and motor nerves and their nerve-centres, all knowledge is acquired. It is in this way, as we know, that we can, through the skin senses, distinguish variations in temperature, perceive pain, and recognise the qualities of things touched; through the sense of vision that we can recognise different objects; through the sense of smell detect the faintest odours, differentiate, and classify them; and through the sense of taste distinguish between sweet, sour, bitter, and saltish substances and different kinds of food, drink, etc. *Putrefaction* in meat of any kind is an interesting example of how the various senses may co-operate to elicit facts, since it can be detected through

sight, touch, taste, smell, and even hearing. It is said that a practised ear can, by using a stethoscope, detect gangrene, in injured or diseased parts of the body, in its early stages, by the peculiar crepitant sounds caused by the presence of gas due to the mortification of the tissues. The following are further examples illustrating how different senses may inter-react in the acquirement of knowledge. Children, who are born deaf or become deaf soon after birth and have never learned to speak, possess, nevertheless, the faculty of voice, and can be taught not only to understand spoken words, but also to read by watching the lips of those speaking to them. This, which is called *lip-reading*, is an example of knowledge acquired through the eye which is normally acquired through the ear. *Deaf-mutes* can be taught both to read and speak, though their speech may be imperfect, and can also converse through an alphabet formed by their fingers. Another example of the kind is that of blind persons who can learn *to read*, through the sense of *touch* in the tips of their fingers, by means of what is called *Braille type*, "a kind of type having arbitrary signs consisting of varying combinations of six points arranged thus (: :), there being sixty-two possible combinations of these six points " (Chambers's Dictionary).

Knowledge is not born in any of us, although some persons may be born with special talents or aptitudes for acquiring knowledge of different kinds, owing to certain portions of their brain cortex being more highly organised than they are in other persons. Knowledge or skill in any professional calling, trade, or occupation can only be acquired, through the senses, by individual effort, and success or failure depends largely upon whether or not the higher faculties of the mind have been properly cultivated.

"We learn by doing! This is the cardinal principle of all acquirement of real knowledge " (Dumville).

PERCEPTION

PERCEPTION is the faculty of reception and recognition of sensory impressions, indirectly, through the associated nerve-tracts. By this means we are enabled to locate sensations in the different parts of the body in which they occur. Perception involves reasoning through which we can revive past impressions formed regarding different kinds of sensation. This implies consciousness. "Our various states of consciousness," wrote Herbert Spencer, "are elaborated out of our perception of change, degree, and facility of changes, etc., all running together in larger and larger groups and series until they embody what is called the *outer world*."

Apperception is the conscious perception of a sensory impression. Whatever is actually perceived as an external object is a *percept* as distinguished from a *concept*, which is a general idea formed in the mind about anything. The main difference between a sensation and perception is that sensation always remains practically the same, whereas perception varies, in consequence of which it may be necessary at times to correct our previous impressions regarding objects and events. In the case of wrong visual impressions, for example, we can, by movements of the eye, look at objects from different angles, and thus derive further information about them, by which we are able to correct them. In the case of the ear, the head can be moved in different directions so as to enable us to identify sounds more readily, and tell the direction from which they come, although it is no easy matter at times to locate the direction from which sounds do come. Dogs have the advantage over human beings in this respect, in that their sense of hearing is much more acute, and in being able to move about

their aural appendages with great facility in intensive listening as when suspicious sounds occur in the night when the members of a household are fast asleep. By giving careful attention to objects when they first come to notice and at other times, thereafter, we get to recognise them automatically. This is termed *practical perception*. On the other hand, if objects are only cursorily examined when first observed the impressions conveyed to the mind regarding them may have to be revised. This is called “*corrected perception*.” The procedure adopted to correct wrong impressions is, as Woodworth says, “A series, in rapid succession, of what are called ‘*trial and error perceptions*.’” Because this involves a more careful examination of objects in order to get fresh stimuli from their more outstanding characters, which combine to correct the perceptive response, the process is termed *analytical perception*. Woodworth gives numerous interesting examples of errors in perception. The following are two: (1) A faint sound was first taken for a bird singing, then for a distant locomotive whistle, and, finally, for what it was—a tinny noise of a piece of metal carried in the hand and brushing against the overcoat as the person walked. In making this series of “error and correction” perceptions, the time occupied was not over five seconds. (2) On touching an object in the dark you may feel it as one thing and another till some response is aroused that fits the known situation, and so satisfies you. What is termed *anticipatory perception* is the act of trying to foresee the possible consequences of our actions. If, for example, our indignation is aroused by an insult or otherwise, we might feel inclined to act in a way that might lead to consequences detrimental to ourselves, and we decide, therefore, either quickly or hesitatingly, to curb our impulses, knowing that discretion is the better part of valour. “Hesitation between perception and

action," observes Woodworth, "may occur in anger due to retaliation or defence, or anticipation of the consequences of the action taken, or it may be due to *substitute perception* when looked at from the other person's point of view."

Besides the forms already mentioned there are many other kinds of perception which can only be referred to here cursorily. The following are some of these, which Woodworth discusses in detail:

1. **The Perception of Space**, which includes, for example, the location of taste, thirst, and hunger, the distances of objects, and the extent of movement of the limbs.

2. **Æsthetic Perception**, by which we recognise what is beautiful in natural objects, music, poetry, or works of art, etc.

3. **Social Perception**, by which, through the senses, we may be able to perceive the motives and intentions of others and form ideas about their character.

4. **Errors of Perception**, as in weighing and measuring things, for which special appliances, such as scales and tapes, are needed to ensure accuracy. These errors may be purely "*errors of sense*" or "*errors of perception*." By way of illustrating "errors of sense," Woodworth writes: "If you come out of a cold room into a warm room, the latter seems warmer than it is; and if you come out of a dark room into a light room, the latter seems brighter than it is." It is astonishing how quickly time seems to pass when one's thoughts are intensely concentrated on anything of interest. Take, for example, a game of chess. Hours may pass in thinking out "moves," and no conception of the time spent on a game may be possible without reference to one's watch. This is entirely an "error of perception," and in no way an "error of sense." Included under this heading are *constant errors* regarding the time of occurrence of events or happenings of any kind, and

“*variable errors*,” due to slight transient causes as, for example, when shooting at a target and trying to hit the bull’s-eye.

5. **Illusions**, which are errors of perception. These have been classified as follows:

(a) *Illusions due to Peculiarities of the Sense Organs*. Woodworth cites the following example: If a pair of compasses, with the points apart, is drawn across the lips from one side, you get the illusion of the points separating more widely at the middle of the mouth, where the sensory nerve-supply is greatest, and coming together again as the points near the other side.

(b) *Illusions due to Pre-occupation or Mental Set*. These are common illusions in persons who are insane; but they occur also in persons with well-balanced minds, as when a mother, with her baby upstairs very much in her thoughts, imagines she hears it crying when a cat yowls or a gramophone starts next door. “The ghost-seeing and burglar-hearing illusions belong here as well” (Woodworth).

(c) *Illusions of the Response-by-Analogy Type*. Analogy is an agreement or correspondence in certain respects between things otherwise different. The illusions based on analogy are perhaps the most common of all kinds. Woodworth gives the perception of the buzzing of a fly or an aeroplane as an example of this type of illusion. Another familiar example is that known as Aristotle’s illusion, in which, when two fingers are crossed and a marble is touched by both fingers, two marbles seem to be touched. Other small objects may be used instead of a marble. Moving pictures are a further example. Their apparent movements are due to the way in which a series of very small snap-shot photographs are thrown on to a screen.

(d) *Illusions due to Imperfect Isolation of the Fact to be perceived*. In this form the figures of objects, depicted by

lines, are used to test the powers of observation. The best example of this illusion is the Müller-Lyer figure: "Two equal lines are embellished with extra lines at their ends; you are supposed to perceive the length of the two main lines, but you are apt to take the whole figure in the rough and perceive the distances between the chief parts. You do not succeed in isolating the precise fact you wish to observe" (Woodworth). The most familiar figure is made with arrow-heads thus: $>---<$ $<--->$ in which both horizontal lines, although the measurements are the same in length, appear to differ because of the arrangement of the arrow-heads. The same illusion occurs if the middle lines are left out, and the figures measured from their points are compared. Other figures giving illusions can be formed out of circles, semicircles, squares, and alphabetical letters. The Poggendorf illusion, the barber-pole illusion, and the Zoellner illusion, which are shown by figures consisting of straight lines, spiral lines round a column, and a straight thick black middle line with numerous small black oblique lines crossing it, are shown in large diagrams and fully explained by Woodworth,* and those interested in illusions might refer to what he has written about them for further information.

INSTINCTS

The Definition of Instinct. Many definitions have been given, of which the following are examples:

1. Action taken in pursuance of an end without any conscious perception of what the end is (Hartmann).
- (2) Inherited memory (Butler).
- (3) A kind of organised memory (Spencer).
- (4) The sum of inherited habits

* "Psychology—A Study of Mental Life." (See pp. 457-459.)

(Murphy). (5) Inherited capability; or more exactly, instinct is the inherited power of acting habitually and without deliberation in a purposeful intelligent fashion under the influence of internal stimuli, plus or minus others from without (Eimer). (6) A reflex action into which is imported the element of consciousness. (7) An involuntary prompting to action.*

The Instincts of the Lower Animals. These are all inborn, and their instinctive responses to stimuli are, for the most part, made in a definitely fixed manner. Some animals, such as, for example, ants, spiders, wasps, bees, birds, dogs, elephants, and monkeys, perform actions of a more intelligent kind than those due solely to instinctive response. That, however, does not imply that they are conscious of the fact, nor are their instincts always faultless, "for ants store beads instead of grains, and mistake corn-wheat seeds for their own cocoons; flower-visiting insects also patronise brightly coloured wall-paper; and the lemmings, in their instinct for going right ahead, will swim straight out to the sea."*

Lemmings, it may be mentioned, are small animals belonging to the genus of rodent quadrupeds which include musk-rats and water-rats.

In the case of human beings, although they display many instincts from the moment of their birth, many others are manifested during the development of the nervous system. This can be demonstrated by studying the activities of children at different stages in their growth. The development of these latent instincts is one of the characteristic differences between the human subject and the lower animals.

The Classification of Instincts. Great diversity of opinion exists as to what should or should not be called instincts,

* "*The Illustrated Chambers's Encyclopædia.*"

and their classification varies according to the views held. Thorndike in his list enumerates about fifty instincts, among which he includes sucking, creeping, standing, and walking, which other writers regard as reflex actions. He also includes the so-called specific *phobias* or fears, of which the following are examples: (a) The dread of spaces or crowds of people (agoraphobia). (b) The dread of being left alone (monophobia). (c) The dread of being in enclosed spaces (claustrophobia). (d) The morbid dread of society (anthrophobia). (e) The dread of high buildings lest they should fall (bataphobia). (f) The dread of being at a height (acrophobia). (g) The dread of disease (pathophobia). (h) The dread of railway journeys (siderodromophobia). (i) The morbid dread of lightning (astraphobia). (j) The dread of everything and everyone (pantophobia). These are all instinctive "dreads" which might be grouped together under one heading, "phobias." The scientific terms applied to the different kinds of phobias may not sound so dreadful if readers will refer to a dictionary for their derivation.

Professo: James includes, in his list of instincts, crying and smiling. And since a child can cry from the moment it is born, it is not unreasonable to assume that crying is instinctive. A child, however, cannot smile then; but in course of its development it learns to smile, and may do so when it is only a few weeks old. And it very soon learns to laugh. Smiling and laughing may, therefore, be considered to be due to the development of latent inherited instinct. McDougall classifies instincts under two heads—viz., (1) instincts proper, and (2) innate tendencies.

Instincts Proper. Under this head are included such instincts only as are accompanied with specific emotions or excitement of some kind. In order to illustrate this, Woodworth cites the case of a "broody" hen which, when

in this condition, responds to a nestful of eggs by sitting on them as she does not at other times. He gives as other examples the nesting of birds and nest-building, mating instincts, the hunting instinct of dogs, and the gregarious instincts which cause animals to associate or live in flocks and herds. To these may be added the social instincts of mankind. While these instincts may not all be due to conscious response to stimuli, it may be assumed that even in a "broody" hen there is, probably, a feeling or prompting of some kind akin to consciousness with, perhaps, also some element of emotion attached to it.

Among what are called "primary emotions," Woodworth in his "Inventory of Instincts and Emotions" mentions anger, fear, lust, grief, mirth or amusement, disgust, curiosity, and the "tender emotion" which is manifested most strongly in a mother's love for her child. Emotions differ from instincts in that they are internal responses or feelings of the nature of a preparation for action when they are aroused, whereas instincts are involuntary promptings to act in a certain way, and are concerned also with the end-reaction or result—that is to say, with the possible consequences of the action taken. Several of the primary emotions are intimately associated with specific instincts, of which Woodworth gives, as examples, *fear* with the instinct to escape, *anger* with the fighting instinct, *lust* with the mating instinct, *tender emotion* with the maternal instinct, and *curiosity* with the exploring instinct.

Innate Tendencies. This term has been adopted to differentiate between instincts proper and reflex actions, such as swallowing, coughing, sneezing, etc., which some writers, as has been said, include in their classification of instincts. But as reflex actions are not ordinarily attended with any emotions which characterise *instincts proper*, they have been classified by McDougall as innate tendencies.

Instinct is a mental phenomenon, which, like a reflex action, consists of a stimulus, a response, and a reaction. Hunger and thirst, for example, are stimuli, searching for food to eat and water to drink are responses, and the acts of eating and drinking are the reactions or end-results. While most reflex actions occur instantly, automatically, and unconsciously, instincts proper tend to persist.

Woodworth* discusses instincts under the following three heads: (1) *Responses to organic needs*—e.g., eating and avoiding injury. (2) *Responses to other persons*—e.g., the mating instinct and the parental instinct. (3) *Play responses*, which he regards as a miscellaneous group, including the playful activity of young children, locomotion, vocalisation, laughter, curiosity, rivalry, and fighting, which he says might be named the *non-specific instincts*, because the stimuli for them are difficult to specify, and suggests that the miscellaneous group might be called the “*play instincts*.” What follows is based mainly on Dumville’s† observations on “*instinct and habit*.” He enumerates the following instincts in man:

1. **The Instinct of Flight and Concealment**, with the emotion of *fear*, such as the fear of loud noises, darkness, and the fear of dogs and of pain.

2. **Repulsion**, with the emotion of *disgust*, as that caused when noxious substances are taken into the mouth, or by the action, speech, or general character of a person.

3. **Curiosity**, with the emotion of *wonder* and the desire to examine unfamiliar objects.

4. **Pugnacity**, with the emotion of *anger*, through one’s own impulses being opposed or thwarted, whether rightly or wrongly.

* “Psychology—A Study of Mental Life.”

† “Child Mind.”

5. **Self-assertion** or **Self-display**, with the emotion of *elation* or *pride*. This instinct, when properly controlled, is, as Dumville says, "a cause of our most persistent endeavour and one of the factors in *emulation* and *rivalry*."

6. **Self-abasement**, with the emotion of *subjection*, such emotion being evoked, for example, by the presence of some person who is regarded as superior to oneself.

7. **Parental Instinct**, with its "tender emotion," which, McDougall affirms, is at the root of all tendencies which exhibit love and tenderness, such as generosity, gratitude, love, pity, benevolence, moral indignation, and even the passion for justice.

8. **The Gregarious Instinct**, which prompts individuals to seek the society of their fellows. "There seems to be," writes Dumville, "an opposed instinct which Professor James calls *secretiveness*. When this is the case, it is well to do all in one's power to increase the attractiveness of social communion. For there is no doubt that our best qualities can only be evoked through fellowship."

9. **The Instinct of Acquisition**, called also at times the *sense of ownership*, and at other times the *collecting instinct*. The sense of ownership makes us take an interest and even pride in books and other things which belong to ourselves. The collecting instinct is exemplified in the collection of specimens—botanical and others—coins, stamps, etc., all of which are of educative value, and the accumulation of money and things of monetary value. With regard to collecting money, Dumville remarks: "A child may be induced to begin to save small sums (though not *all* his coppers), and thus to form a habit of *thrift*. But if it is concentrated almost entirely on money and other valuables, the child being encouraged to hoard up every penny he obtains, it may lay the foundation of *avarice* and even give rise to *kleptomania*." Kleptomania is an insane propensity to steal.

10. **The Instinct of Construction**, which is the impulse to make things. Regarding this instinct Dumville gives the following quotation from Professor James's "Talks to Teachers": "Constructiveness is the instinct most active in children. By the incessant hammering and sawing, dressing and undressing dolls, and putting things together and taking them apart, the child not only trains the muscles to co-ordinate action, but accumulates a store of physical conceptions which are the basis of his knowledge of the material world through life."

Innate tendencies are enumerated by Dumville as follows:

1. **Imitation**, which has three forms, viz., (a) *sympathy*, which implies imitation of those around us. (b) Imitation of *thoughts*, which may be called the yielding to *suggestion*, the tendency to which is called *suggestibility*. (c) Imitation of actions which, because it has no special name, Dumville suggests may be called *imitation proper* or merely imitation. By way of illustrating the meaning of *sympathy* as a form of imitation, he says: "It is well known that if one animal in a herd of wild beasts shows fear and rushes off in flight the others may follow suit." This is noticeable also in the case of a flock of sheep. In these instances the general stampede may not be due to the perception of what may have frightened the first animal and made it scamper off, but to the instinctive emotion of fear. "The sympathetic spread of emotion," says Dumville, "occurs in the same way among children. We often call it the 'sympathy of numbers,'" and ad's, "the 'tone' of a class or school depends largely on the same thing."

But we have other examples, though of more serious import than those pertaining to wild beasts and school-children, in strikes among the working-classes, and in civil disobedience or non-co-operation, or whatever else these

may be called, due largely to the many being influenced by the few and following their lead blindly, not knowing whither they are being led or what the consequences may be.

The term *suggestion* is varied in meaning. As an innate tendency it is the process whereby one person is led to believe something and act on the belief without sufficient reason, and merely because he has been induced to do so by someone else. Through imitation by suggestion the actions, manners, vulgar or refined speech and even accent, and the good or bad habits of those with whom we associate, may be acquired.

2. **Play** is an innate tendency. Not only is it necessary for the normal development of children, but to the very young children, says Dumville, "it is everything." Play is also of great importance to grown-up persons, in that it enables them to keep in a fit state of health."

3. **The Tendency to Seek Pleasure and to Avoid Pain.** Of all innate tendencies this is by far the most powerful and the most general that, by many psychologists, Thorndike and Sully among them, it is called an instinct. Dumville goes even further, and says that this tendency "is such a fundamental feature of all our activity that it should rather be regarded as a *general law* influencing all our mental life. It plays a most important part in the modification and development of all our other instincts and innate tendencies, the particular kinds of habits which are formed being largely due to its influence."

Conation, which is the faculty of free agency, includes desire and volition, which is the act of willing or choosing, may be initiated by many varying stimuli of an emotional kind, and the acts are recorded in the memory. No matter from what stimulus conation arises, pleasure and pain initiate additional conation on their own account. If pleasure results

we tend to repeat an action. If pain results we tend to shrink from repeating it. The additional conation which arises from pleasure is called *appetition*, which is simply appetite or desire. That which arises from pain, causing us to turn away from an action, is called *aversion*. The influence of these factors on the formation of habits is obvious. While much of the pleasure and pain which come into our lives arise from causes external to ourselves and, therefore, beyond our control, yet, on the other hand, we are responsible to a great extent for the pleasure and happiness or the pain and misery in our lives. For being free agents we have a considerable degree of control over our thoughts, our emotions, and our will. But it has become clear that tendencies which give rise to painful experiences can be suppressed by determined mental effort while, on the contrary, tendencies which produce pleasure and happiness grow stronger the more we encourage them, until certain of our actions are performed quite spontaneously, when they are known as *habits*. Finally, instincts, which are merely *repressed*, are by no means eradicated, which explains why so many children who have been severely repressed at home or at school break out into evil ways when in later years they are able to choose their own course of action.

MOTOR ADJUSTMENT THROUGH ACTIVITY

“The term *motor adjustment*,” writes Woodworth, “has been used in psychology with the idea of likening human individuals to an adjustable machine which can be set up for one or another sort of work.” Persons who have never heard of motor adjustment in its application to human activities, when asked the meaning of it, at once conclude

that it has something to do with a motor-car, how to drive it and direct and control its movements. In its psychological bearing motor adjustment is effected through the sensory and motor nerves and nerve centres. It involves perception, reasoning, and experience gained through various activities. It is through the sense of touch, judgment, and adjustment of muscular movements, etc., that individuals become expert in playing tennis, football, cricket, billiards, and other games, and that skill in any trade or occupation is acquired. Success is always accompanied with pleasure, whereas failure is attended with a feeling of painful disappointment. From this it will be seen that motor adjustment and mental activities are closely associated. As illustrating this, Woodworth cites the following examples: (1) That of *hunger*, which is an inner state and adjustment predisposing the individual to make eating movements in response to the presence of food. (2) *Fear*, which is an impulsive adjustment to escape from some seen danger. (3) *Anger*, which is an impulsive adjustment to get at something and attack it. The activities of children are generally cited as a typical instance of motor adjustment. Dumville writes: "Nobody can watch a healthy infant without being struck by his tendency to handle, look at, roll, rattle, bite, and otherwise experiment upon all objects which come within his reach." These activities, however, are accompanied only with the sensation of movement, and the objects convey no meaning whatever to the child. It may play with its toes, and yet be unconscious of the fact that they are part of its own body. But as the movements afford it pleasure, it keeps repeating them. Later, however, the senses of sight and touch develop, and in creeping about the floor or learning to walk it may knock its head against some article of furniture or have a fall, and through painful experience gained in this way the child

learns to adjust its movements so as to avoid risks of the kind in future, and soon gets to know that its head and other parts of its body are its own and how to protect them from injury. "Discovery," says Woodworth, "takes its start with the child's exploratory activity and invention with his manipulation," and says, further, "perception is an adjustment to facts as they are, while motor adjustment is a preparation for changing the facts. Perception does not alter the facts, but takes them as they are; movements alter the facts or produce new facts."

THE FUNCTION OF PLAY

Amusements, diversions, exercises and games of all kinds, and dramas and operas are all included in the term *play*. The instinctive tendency to play is manifested in children in their earliest infancy, and one has only to go to a "Zoo" to see the same instinct displayed in the playful activities of the lower animals. Woodworth, in a chapter on "Instincts and Emotions," discusses *play-instincts* under the heads of playful activity, locomotion, manipulation, exploration, or curiosity, laughter, fighting and self-assertion. The following are a few brief observations under each of these heads:

Playful Activity. Although in its early infancy a child may not be able to make muscular movements of an intelligent kind, its activities, nevertheless, help to develop its muscles, and, in course of time, when its nervous system becomes more highly organised, it is not only able to use its muscles freely, but also to control and adjust their movements.

Locomotion.—There can be little, if any, doubt that creeping and attempting to walk are regarded by a child

merely as play. Most of the lower animals can walk at birth or very soon after; whereas a child's muscles are not sufficiently developed to enable it to do so until several months after birth. They soon learn to walk, however, when their muscles are ready for use, and when they have gained confidence through their own efforts to do so or a little help and encouragement from someone else. Many children could walk sooner than they do were it not that they are restrained in their attempts, at times, lest their legs should become bent. A child has been known to walk when only seven months old, and it has been recorded that a child seventeen months old, that had done nothing but creep before, has practically got up and walked of its own accord. This fact has been cited to support the view that walking is an instinctive reaction.

Vocalisation. This also involves playful muscular activity. And the playful cooing and babbling that appear when a child is a few weeks or months old are mentioned, as examples, by Woodworth, who writes thus: "A child derives satisfaction not so much from the muscular activity of vocalisation as from the sound he produces, so that deaf children, who begin to babble much like other children, lag behind them, as the months go by, from not deriving this auditory satisfaction from the vocal activity"; and adds: "The baby's cheerful babbling is the instinctive basis on which his speech later develops through a process of learning."

Manipulation has been defined as the use of the hands in a skilful manner. So far as very young children are concerned, their manipulation would seem to tend chiefly in the direction of destructiveness. They certainly do not show any skill in their activities when playing with their toys or anything else. Later on, however, they begin to take an interest in their playthings and other objects, and

by handling and examining them carefully gain knowledge about their structure, actions, and uses. "This form of playful activity," says Woodworth, "contains the germ of constructiveness and of inventiveness."

Exploration or Curiosity is the action of searching in order to discover something. It involves the use of all the senses. A child when only a few months old will listen eagerly to the ticking of a watch applied to its ear. It is fascinated by brilliant lights and things of variegated colours, and keeps gazing at them. It can discern the difference between what is sweet to the taste and what is nasty. And, when only a little over a year old, it will bend its head and apply its nose to a bunch of flowers as though to smell them. This, however, may be, for the most part, due to imitation. All this is known to every grown-up person interested in children, who have watched their development in its various stages. "Exploration," observes Woodworth, "though fundamentally a form of playful activity, has great practical value in making the child acquainted with the world. It contains the germ of seeking for knowledge."

Laughter is included in the play-instincts, because it involves muscular effort in playful activity.

Fighting. This may be either playful activity or amount to a *real* stand-up fight, involving the output of great muscular effort. As a rule the stimulus to fighting is restraint or interference. The fighting instinct is born in the lower animals and human individuals alike. Its existence in new-born infants can be demonstrated in the following manner, as described by Woodworth: "Hold the new-born infant's arms tightly against its sides, and you witness a very peculiar reaction: the body stiffens, the breath may be held till the face is 'red with anger'; the child begins to cry and then to scream; the legs are moved up and down, and the arms, if they can be got free, make striking or slashing

movements." In somewhat older children, he adds, "Any sort of restraint or interference with free movement may give a similar picture, except that the motor response is more efficient, consisting in struggling, striking, kicking, and biting." With regard to the fighting spirit in general, the following is a further quotation: "There can be no manner of doubt that pugnacious individuals, dogs or men, get more solid satisfaction from a good fight than from any other amusement." By way of exemplifying the suddenness with which the fighting instinct may be aroused, or what might be, more appropriately, described as "much ado about nothing," the following amusing, though no doubt imaginary incident, given by Woodworth, may be introduced here: "Two women were brought before the judge for fighting, and the judge asked Mrs. Smith to tell how it started. 'Well, it was in this way, your honour. I met Mrs. Brown carrying a basket on her arm, and I says to her, "What have you got in that basket?"' says I. "Eggs," says she. "No," says I. "Yes," says she. "Ye lie!" says I. "Ye lie!" says she. And a "whoop!" says I, and a "whoop!" says she; and that's the way it began, sir.'"

Fighting may be either aggressive, which is making the first attack, or defensive action. As it has so close a connection with the more generalised self-assertive tendency, Woodworth suggests that it might be included under that instinct. It may be regarded, he says, as a special form of self-assertive behaviour often complicated with the emotion of anger.

Self-assertion. It is difficult to trace the element of play in self-assertion. The four forms enumerated by Woodworth are as follows:

1. Defensive reaction to things, overcoming obstruction, putting through what has been undertaken—the success motive.

2. Defensive reaction to persons, resisting domination by them—the independence motive.
 3. Aggressive reaction to things—seeking for power.
 4. Aggressive reaction to persons—seeking to dominate.
- Self-assertion comes more directly under instinctive or innate tendencies.

HABITS AND THEIR FORMATION

Habit has been defined as the ordinary course of conduct or the tendency to perform certain actions. All habits, good and bad alike, are acquired, and become automatic through frequent repetition. Some of them tend to become “instinct-habits,” which have already been discussed. They are so called to distinguish them from instincts proper. Habits include within their range moral, intellectual, and physical activities. “‘Tricks of habit’ are a result of the tendency of certain nerve-groupings to be revived, for it seems to be a law of nerve tissue that what it has done once it is prone to do again ” (Nisbet).

Formation of Habits. Habits are formed in the following ways:

1. *Through Instinctive Reactions.* It is sometimes difficult to determine the instinctive impulse to habits formed in this way, but, as Meredith observes, “Careful observation may give us the key to the problem in individual cases.” Instinctive reactions, which are attended with agreeable emotions, have a strong tendency to be repeated, and habits thus become permanently fixed.

2. *By Purposive Action.* This implies individual effort to perform in a skilful manner whatever duties may be attached to one’s calling in life, whether it be a trade, profession, or any other vocation. All such effort is accom-

panied with the motive of achieving success, and the success which accrues from effort depends largely on the strength of the motive.

3. *By Voluntary Repetition of Reactions.* This applies to habits which individuals can form, of their own accord, by repeated effort and firm determination. They can, for example, acquire the habit of regularity in the time at which they go to bed at night and get up in the morning, take their meals, attend to their hygienic requirements, take exercise or recreation, and so forth. They can, in short, habituate themselves to carrying out their daily concerns and duties, according to a definite programme drawn up by themselves.

4. *Through Inadvertence.* Most so-called bad habits are acquired in this way. Many of them are formed through imitating other persons, and especially those with whom we associate, and the worst type are often formed in early life through instinctive impulses. The following are a few examples of bad habits which might be multiplied indefinitely: Scowling, making faces, picking the nose, promiscuous spitting, biting the nails, slouching when walking, careless postures assumed in sitting or standing, untidiness and uncleanness, unpunctuality, the use of foul language, telling lies, dishonesty, affectation, boasting and egotism. We must not omit to add to these the habit of using cocaine, morphia, Indian hemp, and other dangerous drugs, and the abuse of alcohol and tobacco. There are, besides these, habits which are grouped under the term *sentiment*, examples of which are love and hatred, fellow-feeling and sympathy, anger and fear, devotion to duty, loyalty and patriotism. These, like all other habits, tend to become permanent through being repeated.

General Observations regarding Habits. Some habits may be due to nervousness, and others to bodily defects or

disease. When of the nervous type personal effort may help to overcome the habit, or it may be necessary to employ special measures, in individual cases, in trying to counteract it. Slouching and bad postural habits may be corrected by different kinds of muscular exercises, while those due to physical ailments may be remedied by some simple form of treatment. Since all habits tend to increase in strength and become automatic with practice, it is of the greatest importance that every endeavour should be made in early life to struggle hard against the strong tendency to form bad habits and to acquire and cultivate those that are good. "Habits," it has been said, "are soon acquired, but when we try to strip them off, 'tis being flayed alive." It has also been said that "ill habits gather by unseen degrees, as brooks run rivers, rivers run seas."

MENTAL IMAGES AND IDEAS

Mental or Memory Images are pictures or conceptions in the imagination with more or less likeness to objective realities. As used in optics, the term image is defined as the figure of any object formed by rays of light.

Ideas are mental images of external objects, but the term includes, in its meaning, any product of intellectual action, such as memory, imagination, etc. *Ideation* is the exercise of the mind for forming ideas.

"Mental images," writes Sadler, "are true to life and facts only in so far as our sensations and perceptions have been truly formed and correctly interpreted." Images of objects, and of sensations produced by different varieties of colour, sound, taste, smell or touch, can be revived in the mind without the stimulus, which originally produced them,

being present. Moreover, by a readjustment of original images or ideas new images or ideas can be formed. It has been demonstrated by investigation that the power of reproducing or recalling mental images varies greatly in different individuals. Woodworth refers to what he describes as a kind of census taken by Galton when he asked many persons to call up the appearance of their breakfast table as they had sat down to it on a particular morning, and to compare the image with the sensory experience aroused by the actual presence of the scene. Some of them reported that the image was "in all respects the same as the original sensation," while others denied that they got anything at all in the way of recalled sensation, though they could perfectly well recall definite facts regarding the breakfast table. "So different," observes Woodworth, "are testimonies in this regard that one is forced to conclude that the power of recalling sensations varies from something like 100 per cent. to practically zero." The general opinion seems to be that visual images are more readily and vividly recalled than auditory or kinæsthetic images (Gr. *kinein*, to move; *aisthēsis*, sensation)—the term kinæsthesia meaning "a sense of movement or muscular effort." Persons have come to be classed as *visiles*, *audiles*, and *motiles*, according as their strength of recall is greatest in one or other of the three types of imagery mentioned. "But," says Dumville, "recent researches seem to point to the fact that usually in a given individual there is not a very great difference between the richness of imagery derived from one sense and that derived from another. Many seem to have good imagery *all round*; and some, especially those who do much abstract or general thinking, seem to have poor imagery throughout, except for words (which may occur in any or all of the visual, auditory, and kinæsthetic types)." Since the senses of

taste and smell are so intimately associated in their action, any attempt to separate them into distinct types of mental imagery would be futile. It cannot be denied, however, that the sensory image of the taste of a savoury dish, partaken of long ago it may be, can be recalled as though some of the dainty food were actually in the mouth at the time of recall. The sensory recall of the taste of wines and other drinks seems to be comparatively weak in most people, and such wines, the image of the taste of which can be most realistically recalled, are usually highly flavoured with peppermint, caraway seeds, or other condiments. And no doubt the mental images of both food and flavoured drinks are to a considerable extent due to the recall of the sensory image of smell. Mental images differ in many respects from original percepts. Those arising from sensations are less detailed, less free from doubt as to their correctness, less enduring, less pleasurable in many instances, and in other ways inferior to original sensations. For example, the sensation of pleasure and satisfaction derived from witnessing a play or listening to an orchestral performance far surpasses that of recall. So far as concerns both sensations and percepts, no new facts can be derived from their mental images. But *new facts* can be derived from objects when they become presented to view again, and thereby we get to recognise them more readily. The faces of people with whom we associate become so familiar to us that they can be recalled, even though we may not see them for many years. The recall of words and their meanings enables us to converse with other persons, write letters, essays and stories, describe objects and scenes and relate past experiences of any kind. And in speaking and writing we recall learned speech-movements and writing-movements. "Recall," says Woodworth, "furnishes the raw material for thought. A large share of any one's daily work, whether

it be manual or mental, depends on the recall of previously learned reactions."

Hallucinations are sense impressions—*e.g.*, hearing musical sounds which have no external origin, or seeing objects which are not externally present. These come under the category of mental images and ideas, as also does *reverie* and the day-dream or "brown study" in which the thoughts are disconnected and have no bearing on each other or any definite aim in view. To this process of mental abstraction the term *free association* is applied to distinguish it from *controlled association*, in which facts are linked together in proper order, thus enabling correct ideas to be formed from them.

Optical Images. When discussing the sense of vision we learned that visual sensations are analysed and interpreted by the mind, and depicted in the retina in the form of mental images. The following forms of optical images have been classified: *Aerial image*—*i.e.*, seen as in the air, when the eye is being examined with an ophthalmoscope. *After image*—*i.e.*, the impression which remains in the retina after the image proper has ceased to be visible. If, when an object is being gazed at, the eye is quickly diverted from it, the image can still be observed. *Direct image*, which is a picture from rays of light not yet properly focussed. This is observed when the eye is being examined with an ophthalmoscope. The image seems to be behind the eye, and is magnified and erect. *False image*, which is formed in the deviating eye in squint. *Inverted image*—that is, an image upside down. *Real images*, which are formed when the rays of light emanating from objects are collected and brought to one point in the retina.

In defective eyesight known as *astigmatism* (Gr. *a*, negative, and *stigma*, a point), from which so many persons suffer, the rays are not brought to one point in the retina,

and the images in consequence are indistinct. The trouble may be due to some defect in the shape of the eye, cornea, or lens, and may be complicated with either short-sightedness or long-sightedness.

Optical illusions need only be mentioned as being false or misinterpreted sensory images (see pp. 268-9).

IMAGINATION

Imagination is the faculty of forming or reproducing images of past experiences and facts associated with them which combine to form new facts. Memory depends mainly on the power of imagination, and a good memory on the associations formed at the time of learning. The first stage in the development of imagination is observed in all normal children when they begin to experiment with their toys. It is at this stage, too, that they begin to acquire manual skill and constructiveness. Sadler stresses the importances of educating, training, and curbing the imagination of children, whose early life, he says, is largely one of fantasy, and suggests that instead of telling them so many fairy tales they should be told about facts and people, so as to excite thought and mental concentration, and made to realise that the world is a workshop as well as a playhouse. "It is better," he observes, "to build on fact and learn how to make the real world more attractive to the imaginative little folks; there is plenty that a child will never have to *unlearn* that is both fascinating and satisfying to the imagination." Those responsible for the upbringing of children should avoid telling them about ghosts or other apparitions, or terrifying them by threats of coming evil if they do not behave themselves. It is due to such causes that children so often suffer from night terrors, and develop various

forms of nervous disorder as they grow older. Neurasthenic (Gr. *neuron*, nerve; *asthenia*, weakness) and hysterical persons who are unable to control their thoughts, or assume the responsibilities of life and fight its battles, are largely accounted for by the manner of their early training—their troubles being to a large extent based on the fantasies and imagination of their early childhood. "Such persons," says Sadler, "might be said to possess an automatic power of fantasy, one that acts quite independently of their ordinary mental processes—and one which forms its conclusions and formulates its statements quite without the conscious knowledge of the higher powers of such individuals' minds." "A child of three years," he adds, "will vividly describe his meetings with lions and other wild beasts in the back-yard, and may relate these things as real experiences which have just happened. He is really recalling the pictures of lions from his story books, or reviving the memory-images of the beasts observed at the zoo; and many of our mediums and clairvoyants are so constituted of mind that their own subconscious mind plays the same subtle trick upon them. They see, hear, feel, perceive, and portray as facts the figments of their own imagination."

A revolution in the methods of education was initiated by a German educationist named Friedrich Froebel (1782-1852) with his idea of the "Kindergarten"—i.e., the children's garden (Ger. *kinder*, children; *garten*, garden). He sought to put his ideas into practice in a Kindergarten which he started in 1837 at Blankenburg, in Central Germany, but his ideas did not commend themselves to the authorities, and the school was closed. But at the present day the Froebelian is the system most widely employed in the education of young children up to the age of about seven years. The root of the system is in what was then a novel idea, that to educate a child you must

study child nature. Froebel's object was to enable mothers and teachers *all* to do, consciously, what *some* mothers had done, before his time, unconsciously. The system is based on a metaphor. As we do not, by training, create the nature of a plant but only seek to develop it perfectly according to its own nature, so the child is a plant to be nurtured with the idea of developing to perfection the natural instincts of the child. "Find what Nature wills," says Froebel, "and do that." So came the idea of the Kindergarten. The school is the garden, and the children are the plants. In the Kindergarten the child's instincts are harnessed and guided and made to serve in his development.

The Froebelian system is based on two main principles:

1. *That life is one organic whole.* Each stage—infancy, childhood, adolescence, maturity, age—should be perfect in itself, but should flow naturally one from the other without any sharp transition. "There is not an object of man's thought or feeling which has not its root in childhood." Hence the necessity for perfection in the early stages.

2. *The need of the child for manual work.* "God," says Froebel, "created man in His own image; therefore man, like God, ought to create and work." It will now be apparent that one of the aims of the Kindergarten is *the development of the imagination*, and to this end certain apparatus, technically known as "gifts" and "occupations," is employed. The *gifts* are in the nature of toys—not the modern over-elaborate toys which leave no scope for the imagination, but rather they are raw material on which the child's imagination may work. But they must not be regarded merely as toys or pastimes which are employed because they are attractive to children. They are employed because they have in themselves a definite intellectual character, and because they have the effect of

stimulating individual mental effort. The "gifts" are six in number:

1. Six balls of wool: the primary and the secondary colours.

2. A wooden sphere, cylinder, and cube.

- 3, 4, 5, and 6. A wooden cube divided up in various ways into smaller cubes and prisms of different shapes and sizes. These are used to make different combinations in accordance with the child's imagining:

- (1) *Forms of beauty*—i.e., pleasing to the eye by reason of their symmetry and proportion.

- (2) *Forms of knowledge*, illustrating number and ratio.

- (3) *Forms of life*, the combinations representing real objects—e.g., house, train, pieces of furniture, etc.

The "occupations" also give great scope for the development of the imagination. They include the making of patterns with coloured beads, sticklaying, making designs with laths (thin cleft slips of wood), sewing, paperfolding, and papercutting, matplaiting and brushwork. Kindergarten methods are also carried into all other parts of the school work in drill and songs, in walks and short journeys, and in telling of stories. One word of warning should be added. In such a brief paragraph as this an idea of the *letter* of Kindergarten can be given, but it is quite impossible to convey any idea of its *spirit*. And here, as elsewhere, "the letter killeth, but the spirit giveth life." The Froebelian system has obvious defects, and its results should not be judged by the work of those who are ill-acquainted or out of sympathy with it. Kindergarten methods can only be successful when they are employed by sympathetic, enthusiastic, and well-trained teachers.

The following forms of imagination have been classified:

1. *Reproductive imagination*, which is the act of recalling, in the form of images or ideas, past experiences regarding

objects, sensations, scenes, events, and so forth. It is closely allied to memory.

2. *Interpretative or constructive imagination*, which is the act of explaining, in a lucid manner, recalled facts which are related to or are representations of original images. This is illustrated in a dramatic performance, in which the actors seek to represent a story of human life and action by imitating the language, dress, habits, customs, etc., of the original characters.

3. *Originative or Creative Imagination*. This is the power of bringing into existence new facts relating to past experiences. "Strictly speaking," says Dumville, "there is nothing absolutely original or creative in this process. In the mental world, just as in the physical, man can create nothing. He can only rearrange and modify what already exists. The sublimest 'creations' of poets and romancers are constructed out of ideas already in their possession." "It is," as Sadler says, "the province of creative imagination to take our ideas and fashion them into ideals."

4. *Controlled Imagination*. This form of imagination can only be called into action by having some definite aim or object in view. Before beginning to build a house, for example, details as to its general structure, cost, etc., have to be considered, and plans prepared according to which the work is carried out.

5. *Free or Uncontrolled Imagination*. In this form of imagination there is no motive in view. It is, as Woodworth says, "a kind of play which usually if not always contains an element of imagination or invention, and is exhibited in highest degree in children playing with their toys, the effect of play being that of a stimulus to free imagination."

The terms imagination, fancy, and fantasy are often confused and made use of as though they were synonymous

in meaning. While imagination and fancy may in some instances express the same meaning, the terms fancy and fantasy are not interchangeable. "Fantasy," says Sadler, "represents what may be called the playhouse of the soul. It represents 'consciousness adrift,' or a state of mind in which the thoughts are uncontrolled."

ASSOCIATION OF IDEAS

Association of Ideas is a mental process by which ideas regarding natural objects, sensations, states of feeling, actions, and past experiences of any kind are linked together, thereby facilitating their recall in the form of mental images. How the linkage is effected has been explained in the chapters on "The Nervous System" and "The Acquisition of Knowledge through the Senses" (see pp. 238, 242-5, 261-4). All that need now be restated is that the strength or weakness of the linkage of ideas depends largely on the extent to which the mental faculties are exercised. When, for example, keen interest is aroused in any object, perception is stimulated to activity and the ideas formed regarding the object become, thereby, more strongly linked together and more easily and vividly recalled to memory than ideas formed about an object which aroused little or no interest. The same observations apply to sensations and all other mental impressions, no matter how they originate. What has now been said may help to explain the signification of the term association of ideas, which is regarded as the most pervading fact at the foundation of intelligence, and forms the basis of all habits and systems of memory training. Locke, who was the first to use the term "association of ideas," wrote: "Ideas, that in themselves are not of kin, come to be so united in other men's minds that it is very,,

hard to separate them; they always keep in company, and the one no sooner comes into the understanding but its associate appears with it; and if there are more than two which are united, the whole gang *always inseparable* show themselves together.”*

Writers on this subject were formerly in the habit of writing—and, indeed, some still do—as though there were a number of different kinds of associations, but it must be clearly understood that there is only one kind of association. The working of the law is the same in every case, though merely for convenience we may divide it into several groups. Some writers, for example, recognise three kinds of association—viz., association by similarity, association by contrast, and association by contiguity. Others hold that the last of these includes and embraces the other two. But Dumville would appear to object even to the phrase “association by contiguity” on the ground that it implies that there are other kinds of association. He holds, however, the view that the principle of association by contiguity is at the basis of all associations, and adduces strong and convincing arguments in favour of his contention. As an improvement on the “law of association by contiguity,” Woodworth has suggested the substitution of the “law of combination,” as applied to learning, “which attempts to show how it comes about that a stimulus, originally unable to arouse a certain response, acquires the power of arousing it; and the law states that this occurs only when the originally ineffective stimulus is combined with other stimuli which can and do arouse the response.” But since association by similarity and association by contiguity are still referred to and described in books on psychology, a few observations may be made regarding each to make this chapter complete.

* Quoted by Dumville, “Child Mind,” p. 31.

Association by Similarity. Two different things may look so much alike that one of them, when seen for the first time, may be mistaken for the other with which we are quite familiar. The mistake occurs through each of them having something in common. But when we come to examine them with care they are found to differ materially in many respects. For example, a strange face, with some prominent traits which attract special notice, may be mistaken for that of an old friend or intimate acquaintance. Association by similarity has much to do with the ability to invent or find out something new, and reasoning and imagination depend largely upon it.

Association by contiguity differs from that of association by similarity in that it effects the immediate recall of facts relating to all mental processes, whether as regards actions, sensations, states of feeling and ideas, or the time, place, manner of recurrence or relationship to each other. The principle of association by contiguity applies alike to ideas regarding objects and sensations, all learned movements in trades and other acquisitions. In typical cases of association by contiguity when one thing reminds us of another, both of which were associated in past experience and related to each other, an unitary response recalls both of them. The following are two good examples given in Chambers's *Encyclopædia*: (1) When we see the sky overcast, we think of rain as about to follow, the notion of rain not having previously been present to our mind. (2) If an object is before our eye—*e.g.*, a mountain—we receive an impression or sensation of it, in consequence of the actual presence of the thing; but it is possible for us to remember the mountain, or to have an idea of it, when far from the reality, in which case there must be some power in the mind itself different from the susceptibility to present objects, a power of retaining, revivifying, or resuscitating those states at first

induced by contact with the actual. Speech is the recall of words by knowing their meanings, and a single spoken, written, or printed word—*e.g.*, Macbeth or Hamlet—might be sufficient to recall to some memories the whole of either or both these Shakespearean plays.

Simultaneous and Successive Association. *Simultaneous Association.* From what has been written above, the reader may think that the association of ideas is a simple phenomenon, but in reality it is highly complex. In the adult mind, most of our perceptions are not pure, but mixed. An object enters into the consciousness as a sensation, and, to quote Titchener, "this sensation has fixed habits of connection with other central sensations. Hence, when it arises, they necessarily arise with it. When the sensation comes, it comes with a bevy of inside sensations clustered about it." That is, "the assimilations and symbolic perceptions of our minds are put together by way of simultaneous association." To use Titchener's example, if walking along a country road we suddenly hear a rumbling sound, we know at once that it is a carriage coming from behind us. We locate it as being at a certain distance from us, but sounds themselves cannot give rise to space perceptions, so that there must be another explanation of our ability to place the noise. "The fact is, when the noise takes its place among the processes composing your consciousness, it brings with it a number of central supplements. If you are eye-minded these are visual: a picture of the carriage at a particular place upon the road. If you are ear-minded, they are auditory; the sound of the words, 'There is a carriage just there, so far behind. . . .' In reality, then, the noise is perceived as coming from a particular thing and place only indirectly by way of simultaneous association."

Successive Association. When a second idea enters our

mind by reason of simultaneous association with the first, the process does not stop there, but the second gives rise to a third, to a fourth, and so on, and a train of ideas is formed in our mind by successive association. We ourselves can trace the course of the ideas, but another person would be bewildered if we told him the first and the last ideas without the connecting links. For any one of the many sensations contained in the first perception has habits of connection, and the mind may go in any one of many directions to arrive at the second idea, and so on, to the third and fourth. The reader, recalling many a daydream or reverie, or "castle-in-the-air," will be able to furnish many examples for himself. An extremely interesting illustration will be found in the introduction to one of Edgar Allan Poe's tales of mystery and imagination: "The Murders in The Rue Morgue"; the reader will realise, however, as he reads, that it is highly improbable that the two men each starting from the fruiterer "who ran up against you . . . fifteen minutes ago" would both arrive, at the end of a long train of ideas, at the same idea at the same moment, since each idea provides a great variety of starting-points for the next.

The Influence of Interest on Association. In the last paragraph we suggested that an idea would originate very different trains of ideas in the minds of different people, the reason being that the direction and character of our associations is dependent upon our individual interests and abilities. An artist associates a red sky with a picture, a farmer with his crops. An idea in our mind cannot possibly form an association with another which is entirely outside the limits of our experience, but the more frequently an idea is present in our mind, in our daily work, our pleasures, our hobbies, our family life, the more likely it is to enter into association with other ideas, and the more likely are our trains of ideas to turn in certain directions.

MEMORY

Memory. In her introductory remarks on "Special Studies Connected with Memory," in chapter vii. of her handbook on "Modern Psychology," Christabel M. Meredith writes: "Few writers now dare to use the word 'memory' in the singular without hastening to explain that they mean not 'memory' but 'memories,' and that they are well aware that such a statement as 'John has a good memory' is meaningless unless we say to which of John's memories in particular we refer." So that, bearing this in mind, we may define memory in its application to individual memories as "the power of the mind to retain impressions of objects, sensations, actions, habits and tendencies, and past experiences generally, and to reproduce them in the form of mental images." Sadler defines memory as "the physical register of mental experience or the consciousness of the restimulation or awakening of the physical registries of past experience." The question as to how memory originates is a vexed one; but the general belief seems to be that, like all other mental faculties, it is based on hereditary and instinctive promptings, and that its development proceeds as the neurones and associated nerve-tracts become more highly organised. The strength of recall of past memories depends, largely, upon whether or not percepts, associated with the memories, aroused interest at the time of occurrence, and whether facts connected with them were attentively regarded and understood. Although all past experiences may not be recorded in the neural areas of the cortex of the brain, such of them as may have made deep and lasting impressions can normally be reproduced in more or less detail. Besides, there is every reason to assume, from observations made by Sadler and others, that past

experiences are grouped and sorted in the neural areas, and that facts connected with the experiences can, under certain conditions and within reasonable time-limits, be recalled and reproduced in logical order. "The human brain in its behaviour," says Sadler, "is in many respects analogous to a phonograph record, while the mind performs in the capacity of that power which operates, utilises, reproduces, and otherwise manipulates those things recorded on the brain through the sensory receiving apparatus of the body." So firmly rooted may past memories be that some very aged persons who can no longer memorise anything new may yet be able to recall episodes of their early childhood, and repeat, word for word, verses of poetry and long passages of prose which they learned at school.

The consideration of the subject of this chapter lends itself, more readily than much other of the subject-matter of psychology, to experiment and mathematical statement. The American psychologists have done a great deal of work in this direction. This chapter follows in the main Woodworth's treatment of the subject; and though the mathematical results of the experiments he quotes have been omitted, students who are sufficiently interested may find them in his book. He discusses the problems of memory under four heads—viz.:

1. Memorising (or learning).
2. Retention.
3. Recall.
4. Recognition.

Memorising or Learning. Much of what is known about memory and learning is due to laboratory experiments with *nonsense material* in the form of figures and words, *paired associates* of words, *connected passages* of prose or poetry,

and experiments in *economy of memorising*. The following are examples:

1. Suppose a list of twenty one-placed numbers, such as those below, is given:

5 7 4 0 6 2 7 3 5 1 4 0 9 2 8 6 3 8 0 1.

This list might be memorised by frequent mechanical repetition of the figures, but it would be a slow process because there is nothing characteristic about them. But if the figures are separated into groups by commas and semi-colons thus:

5, 74, 0; 62,73; 5 1 4 0; 9,286; 380, 1,

they can be analysed and memorised much more easily and much more easily recalled.

2. Take a list of nonsense syllables such as—

wok pam zut bip seg ron taz vis lub mer koj yad.

The syllables might be learned by observing similarities and contrasts, by reading meanings into them, and by grouping them into pairs or otherwise and making them rhyme. "One who learns many lists in the course of a laboratory experiment," writes Woodworth, "develops a system of grouping. First he reads a list through in groups of two, three, or four items, noticing each group as a whole; later he notices the items in each group and how they are related to each other. He also notices the interrelations of different groups and the position of each group in the total series. All this is quite different from a mere droning along through the items of the list; it is much more active and much more observant."

3. Suppose an experiment is conducted by the method

of "paired associates." The person to be tested is handed a list of words—*e.g.*, the following:

| | |
|---------------------|-------------|
| soprano | emblem |
| grassy | concise |
| nothing | ginger |
| far away | kettle |
| shadow | next |
| mercy | scrub |
| hilltop | internal |
| recite | shoe-string |
| narrative | thunder |
| seldom | harbour |

and so on.

What is required in this experiment is that the person tested should respond by giving the second word when the first is mentioned. In learning to do this the two words may become linked in the person's memory by the sound or look of the words or connection in their meanings to form a unit which simplifies response. If the test is immediately applied after a few readings, 100 per cent. may be scored. But, observes Woodworth, "if the test be suddenly varied and the person is asked to recite the pairs in order of the list, or to tell after completing one pair what was the first word of the next pair, he may be unable to do so, and protest that the test is not fair, since he paid no attention to the order of the pairs, but concentrated wholly on each pair separately." The process of memorising *connected passages* of prose or poetry consists, chiefly, in the observation of the sense and meaning of the passages, the grammatical structure of sentences and phrases, and any characteristic in the phraseology of the writer. "A connected passage can in this way be learned," says Woodworth, "in a fraction of the time needed to memorise an equally long list of unrelated words,"

and adds, "if a student gets the point with absolute clearness, he has pretty well committed to memory."

We now come to "economy in memorising," which, it may be explained, means wasting as little time and mental effort as possible in endeavouring to commit to memory. Among the methods employed for this purpose are recitation, spaced and unspaced repetition, and whole *versus* part learning.

Recitation. As applied to memorising, recitation is the act of reading aloud to oneself at intervals what one is trying to learn, with occasional reference to the subject-matter. "Where the sense rather than the exact wording of a lesson has to be learned, it is probably best to recite in outline after the first reading, and to utilise the next reading for filling in the outline" (Woodworth). A very good way to improve the memory and add to one's knowledge is to attend public lectures, take part in debates, or ask questions about what is not grasped clearly. Another way is to write a paper and read it at a social gathering, and listen attentively to what is said about it in any debate that follows, whether adverse or flattering.

From the results of the experiments on recitation, described by Woodworth, the following rules may be regarded as established:

(a) *The Value of Recitation in Memorising.* The subject-matter is always more easily memorised by recitation than by reading. The advantage of recitation over reading is even more marked after an interval of time than immediately after the effort to memorise—*i.e.*, the inevitable forgetting is slower after recitation than after reading.

(b) *Spaced and Unspaced Repetition.* The subject-matter is more effectively memorised if the repetitions are distributed in time—*e.g.*, if a passage is repeated twelve times in succession it will not be as well memorised as if it had been

repeated the same number of times with an interval of five minutes, or an hour, or a day between each repetition.

(c) *Whole and Part Learning.* It has been proved by experiment that the easiest and most effective method of memorising—e.g., a poem—is to repeat the whole passage every time, and not to learn it by portions and then piece them together. This latter method involves unnecessary labour, and what is memorised is not so well retained as it would have been had the passage been learned as a whole.

Woodworth describes in detail other experiments, the results of which appear to show that there are exceptions to the rules which have just been stated concerning the advantages of spaced learning and of whole learning. This apparent contradiction, he suggests, should warn us not to accept the rules blindly, but rather “to analyse the factors in each method, and govern ourselves accordingly.”

Among the factors involved he mentions and discusses the following four:

1. *The factor of interest, confidence, and visible accomplishment—i.e.,* obvious progress. This factor is on the side of memorising by parts rather than as a whole. When the learner is confronted with a long lesson, he may despair of ever being able to learn it by repeatedly reading it as a whole, and consequently may lose interest. It is also in favour of unspaced as against spaced repetition, especially in the case of shorter passages. When the learner is making progress he prefers to finish the task rather than to wait for another day. “To have a task that you can accomplish at once, and to attack it with the intention of mastering it at once, is very stimulating” (Woodworth).

2. *The Factor of Recency.* Newly learned acts can easily be repeated, and facts which have just been observed can be easily made use of. The factor of recency counts in favour of both part learning and whole learning.

3. *The Factor of Meaning, Outlining, and Broad Relationships.* This is in favour of whole learning, because the learner catches the drift and notices the connections of the several parts and their positions in what is being learned. "Even if the part method is preferred, it is wise," says Woodworth, "to begin by a careful study of the whole."

4. *The Factor of Permanency.* This is on the side of spaced learning. Since the neurones benefit by rest, spaced learning gives more durable results than unspaced.

Retention. This is the process on which the value of memorising depends. We all know, by painful experience, that it is very difficult to memorise, but very easy to forget. Retention is the process by which ideas or thoughts which have entered the mind are stored there for future use. Woodworth describes it as a resting state in which learned actions remain until aroused by appropriate stimuli. It is well known that neglect to exercise the mental faculties—i.e., to make use of the "appropriate stimuli"—leads to wasting of the cortex in the associated areas of the brain, and, consequently, to impairment of the intellect. Although the degree of retentiveness in each individual case depends mainly upon the inborn quality of the brain, yet just as the power of retention may be lost through lack of exercise, so, on the other hand, it may be increased by training.

Recall. This is a process of memory by which learned reactions can be automatically called back to mind in response to suitable stimuli. It is the third stage of the sequence—memorising, retaining, recalling. Recall depends for the most part on association of ideas. At times, when one is suffering from mental fatigue or subjected to constant interruptions when engaged in a task which requires much mental effort, or, when one is suffering from emotional stress, such as worry, anxiety, grief, fear, or self-consciousness, it would seem well-nigh impossible to recall

anything to memory, while, in other circumstances, thoughts by the process of association flood into the mind like a deluge.

Failure to recall is due to response being temporarily *inhibited*—i.e., checked. This happens, for example, when we are highly self-conscious or when we suffer from stage fright. The particular response which we wish to recall, or the particular idea which we decide to associate with that which has gone immediately before, is supplanted by some other which we neither desire nor design. We know that there should be another idea in our mind, so we grope for it, we hesitate and “break down.”

As *helps in recall*, the following is a condensed summary of suggestions made by Woodworth: Have no doubt as to your ability to recall, know your subject well, and in public speaking have confidence in yourself; avoid worry and self-consciousness, and trust to your ideas to recall the words needed. If you are trying to recall names or anything else you know, but have forgotten, drop the matter for a short time and return to it afresh. The interval of rest puts you on the right track, and recall then becomes possible.

Recognition. Recognition is concerned with perceptions, remembering with ideas. “When a perception or group of perceptions has the mark of familiarity upon it, we speak of recognising someone or something. When it is an idea or group of ideas that bears the mark, we speak of remembering someone or something” (Titchener). Recognition is a simpler process than recall, “but any theory that makes recognition dependent upon recall,” observes Woodworth, “can scarcely be correct. . . . The baby,” he says, “shows signs of recognising persons and things before he shows signs of recall, and a little later understands words before he begins to speak (recall) them.” One theory held is that an object is recognised by recalling its original setting in past

experience—*e.g.*, an odour. “Now sometimes it does happen that an odour which seems familiar, but cannot be identified, calls up a past experience and thus is fully recognised, but such ‘indirect recognition’ is not the usual thing,” says Woodworth, “for direct recognition commonly takes place before recall of the past experience has time to occur. You see a person and know him at once, though it may require some moments before you can recall where and when you have seen him before.”

Memory Training. The most important factors in this process are careful observation of percepts and understanding of facts connected with them, interest and attention, confidence in one’s ability to memorise, and firm resolution to do so. And since the formation of habits, the development of judgment and self-control, and the acquirement of knowledge of all kinds begin in the earliest years of life and greatly influence the recall of what is stored in the memory, it is of the greatest importance, to use the words of Harford, “that the best methods of training should be encouraged from the cradle upwards.” So far as laboratory experiments are concerned, all that can be said about them is that while they may improve the memory regarding nonsense and other material used in the tests, “they do not pretend to develop any general ‘power of memory,’ and the much-advertised systems of memory training are no more justified in such a claim. What is developed in both cases is skill in memorising certain kinds of material so as to pass certain forms of memory test” (Woodworth).

Mnemonics (Gr. *mnēmonikos-mnēmōn*, mindful) is the name given to various artifices by which the memory is assisted more easily to retain and to recall to the mind any fact or number, or a series of disconnected facts or figures. Mnemonics are exceedingly useful at times, but

they do not improve, nor probably do they impair, the general power of memory. A mnemonic by which the colours of the rainbow in their order may be remembered is—

Richard Of York Gained Battles In Vain.
Red, Orange, Yellow, Green, Blue, Indigo, Violet.

Readers who are acquainted with formal logic will recognise the mnemonic which is almost indispensable to the student—the five lines of pseudo-Latin which begin: Barbara, Celarent, Darii, Ferioque, prioris—in which all the consonants and vowels easily recall a series of facts which otherwise it would be very difficult to assimilate. But the most useful mnemonics are those which we create for ourselves.

This heading could not be more adequately concluded than by giving the following further quotation: “In training the memory for the significant facts that constitute the individual’s knowledge of his business in life, the best rule is to systematise and interrelate the facts into a coherent whole. Thus, a bigger and stronger stimulus is provided for the recall of any item. This, along with the principles of ‘economy’ in memorising, is the best suggestion that psychology has to make towards memory improvement” (Woodworth).

The object of remembering things is to enable us to recall those things which will be of use to us. The power to forget useless things is of great value. An efficient mind is one which can remember that which is useful and forget that which there is no need to remember.

Memory Abnormalities. Four different kinds are recognised by psychologists. These are: (1) *Imperfect impression* due to weakness of sensory stimuli. (2) *Imperfect retention*, as in cases of accident when persons, after recovery from concussion, cannot recall what happened immediately before

the accident. In certain instances it may be possible for them to recall some details a few days afterwards. (3) *Imperfect reproduction*, as when patients are unable properly to recall past experiences or where the memory for certain things only may be lost. "Dissociation of ideas," writes Sadler, "is the explanation of those interesting and remarkable cases where long periods of time are literally blotted out of the mind—at least, out of the conscious mind." In some such cases the memories of past experience can be recovered in the hypnotic state. (4) *Defective memory due to disturbance of recognition*. There are four groups of this kind of memory: (a) Cases of complete failure of memory or of "never having seen" as Sadler puts it. (b) Cases in which there is the illusion of having already seen places, scenery, and so forth, which have not been seen. (c) *Distortion of memory*, in which fictitious details are mixed up with facts connected with past experiences. (d) *Retroactive memory*, which is attaching to memory what a person may have heard about things which happened before he was born, and getting to think that he actually remembers them.*

REASONING

Reason is a faculty of the mind by which conclusions are drawn, and right, truth, and justice determined.

Reasoning is the course of argument followed in endeavouring to arrive at correct conclusions. To do so requires careful observation of all facts relating to questions involved in doubt, and weighing the evidence in favour of or against the arguments adduced. In lawsuits, *e.g.*, the conclusions or findings of the court may be based on what is called circumstantial evidence—*i.e.*, evidence which is not

* Sadler, "The Mind at Mischief," pp. 334-5

positive nor direct, but which is gathered inferentially from the circumstances of the case. Reasoning involves the necessity of having some motive or end in view, and forming ideas as to how best to attain the desired result. The question as to whether the lower animals possess the faculty of reason has occasioned much discussion, and many persons incline to the view that they do possess it. With regard to the dog, which is considered to be one of the most intelligent of animals, Woodworth writes: "There is nothing to indicate that the animal recalls facts previously observed, or sees their bearing on the problem in hand. He works by motor exploration instead of mental. He does not search for 'considerations' that may furnish a clue. What the human behaviour does show that is most absent from the animal is (1) attentive studying over the problem, scrutinising it on various sides in the effort to find a clue; (2) thinking typically with closed eyes or abstracted gaze in the effort to recall something that may bear on the problem; and (3) sudden 'insights,' when the present problem is seen in the light of past experience." It is well known to those who have attempted the task that the solution of deductions, based on known propositions, when no definite clue is given to their solution, involves much greater mental concentration and effort, and keener reasoning, than original propositions. There are various types of reasoning, of which the following have been mentioned by Woodworth:

1. Reasoning Out the Solution of a Practical Problem. "A problem," Woodworth writes, "is a situation in which we have no ready and successful response. We must *find out* what to do. We observe facts which recall previous experiences or previously learned rules and principles and apply them to the problem in hand. If our exploration is successful we observe a real clue, recall a guiding principle and find the solution."

2. **Rationalisation or Self-Justification.** Rationalisation is subjection to reasonable *principles* which are the fundamental truths on which other truths are based. Self-justification simply means that one must be able to give a sufficient reason for one's conclusion regarding any question at issue. It may be considered as a plea to justify one's actions whether they have been performed or are pre-meditated, or, as Woodworth puts it, "a reasonable *motive*, some acceptable general principle that explains our action."

3. **Explanation**, which is an attempt to make clear, by giving reasons for their existence, facts which may be difficult to understand.

4. **Application.** This form of reasoning differs from those described above in that, as Woodworth endeavours to explain, "instead of searching a concrete situation for clues and searching your memory for general principles, you search your memory for particular cases where the general law should apply. If all animals are cold-blooded, excepting only birds and mammals, then fish and frogs and lizards are cold-blooded, and spiders, insects, lobsters, and worms; having drawn these inferences, your understanding of the general proposition becomes more complete."

5. **Doubt**, which is uncertainty of mind or hesitation to believe. If assertions are made during an argument or debate the truth of which is disputed, this form of reasoning is at once employed and instances quoted from memory to show that the statements made are not in keeping with facts. This is illustrated by Woodworth as follows: "You say that all politicians are grafters. Theodore Roosevelt was a politician; therefore, according to you, he must have been a grafter. But he was not a grafter, and you will have to take back that sweeping assertion."

6. **Verification**, which involves hypothetical reasoning—an hypothesis being a proposition assumed for the sake of

argument, or a theory to be proved or disproved by reference to facts. All propositions coming under this form of reasoning have to be analysed in order to ascertain whether they are true or false. An interesting illustration, and one which explains clearly the meaning of verification by reasoning, is that of the discovery of the circulation of the blood by Harvey. The line of hypothetical reasoning pursued by Harvey was as follows: "If the blood is driven by the heart through the arteries, and returns to the heart by way of the veins, then the flow of blood in any particular artery must be away from the heart, and in any vein towards the heart. Further, there should be little tubes leading from the smallest arteries over into the smallest veins" (Woodworth). These deductions were all verified later when it became possible to observe, through a high-powered microscope, the minute capillary bloodvessels.

This chapter would be incomplete without some brief reference to two methods within which all acts of reasoning are included. Like M. Jourdain, in Molière's play, who was surprised to learn that, without knowing it, he had been speaking prose all his life, many people would be surprised to learn that all their life their acts of reasoning have been either deductive or inductive.

Deductive Reasoning is the application of a general truth to a particular case; it is the act of proceeding from the known to the unknown—*e.g.*, all liquids which turn blue litmus paper red are acids. This liquid turns blue litmus paper red. Therefore this liquid is an acid. It should be noted in passing that all acts of reasoning can be set out formally as above in a series of short propositions (two premises and a conclusion), to which in logic the name "syllogism" is given. Many of our actions and speeches are the conclusion of a deductive syllogism in which one or more premises may appear to be lacking, but on further

consideration they will always be found to be present, but so obvious that we take them for granted—*e.g.*, I am going out for a walk. I glance up at the sky, and then I take either my umbrella or my walking-stick. On my friend Mr. X.'s advice I invest my money, without hesitation, in a certain company. These and all our other acts of reasoning may be reduced to syllogistic form thus:

Mr. X.'s advice is always perfectly sound.

To invest in this company is a piece of Mr. X.'s advice.

Therefore, it is perfectly sound.

Inductive Reasoning. In this we consider a large number of particular instances, and from what we observe as common to them all we draw a general conclusion covering them all. The syllogism will be set out thus:

This, that, and a number of other liquids all turn blue litmus paper red.

This, that, etc., are all acids.

Therefore all acids turn blue litmus paper red.

Induction, then, is the formation of general laws, but the danger is that we shall generalise too hastily, jump to conclusions, like the lady who always treats you as a confirmed invalid because you had tonsilitis nine years ago. Induction is a much more difficult and important process than deduction. It requires infinitely greater power of observation, knowledge, intuition. The greater part, if not, as some philosophers think, the whole of our knowledge is the result of the inductive process. The aim of modern science being the establishment of universals, the name "induction" is now frequently applied to the complete process including deduction. Accepting this view, the inductive process would include—

1. **Observation**—the consideration of a great number of isolated facts—a very difficult process. "There is not one person in a hundred," says Huxley, "who can describe

the commonest occurrence with even an approach to accuracy."

2. **Hypothesis**—an inspired guess at a general law embracing all the observed facts. This hypothesis may, or may not, be correct; so there follows:

3. **Verification**—the deductive stage—testing the hypothesis by applying to it further facts. If it is found not to apply throughout to facts of a like nature, it is rejected and another hypothesis formed. So the process continues until the hypothesis is established, when it becomes a theory or a law, the difference between a theory and a law being that a law states one universal relation, while a theory is a wider generalisation which may cover many laws—*e.g.*, the theory of evolution or Einstein's theory of relativity each include a wide area of knowledge, within which a great number of laws will be formulated as time goes on.

While we have here alluded but briefly and simply to the subject of scientific reasoning in so far as it comes within our province, the subject is much wider and more difficult than we have indicated, and the student who desires to read further upon the subject should consult textbooks on logic.

INTEREST AND ATTENTION

Attention may be defined as the application of mental energy to a given object or, in other words, the function of attention is to single out from consciousness one idea for special treatment.

Interest is the force which directs attention or determines the point to which it shall be applied. As a general rule, the greater the interest we take in an object, the greater is the attention we give to it. This is so obvious that there is no need to give examples. But the converse is not true. We

may give a great amount of attention to an object, but our interest in that object is not necessarily correspondingly great—*e.g.*, a child writing out lines as a punishment or learning tables by heart. McDougall sums it up in these words: “To have an interest in any object is to be ready to pay attention to it. Interest is latent attention, and attention is interest in action.” The relationship between interest and attention may be illustrated by an example—I am driving a car, and as long as the engine is humming normally I give it scant attention. I hear a sudden rattling noise in the machinery. Instantly I concentrate attention upon it, but if I recognise the sound and know it to be harmless, I cease to be interested and my attention is free for other objects. But as long as I do not know the cause of the noise I am acutely interested in it because I do not know what effect it will have upon the car and me. What, then, is *the cause of interest*? Animals are interested in anything which arouses any of the fundamental instincts, the interest varying according to circumstances—*e.g.*, a plate of food interests a hungry dog, but when full to satiety the dog will only be interested to the extent of sniffing at the food and turning away. The same rule applies to man, but man has power, more or less, to control the instincts; and, further, man is a more complex being than the lower animals, and is governed not only by the fundamental instincts, but by many other factors, such as, *e.g.*, the emotions of love and hatred, sympathy, generosity, and so on; by heredity, training, social environment, and by the thought which may be prominent in his mind at a particular moment. “The one interest which dominates all others,” says Dumville, “is the interest in ourselves.” This is a provision of nature to ensure the preservation and maintenance of the race. There are many events and objects which evoke no interest, and so attract no attention when they are concerned with

other people, which would be of absorbing interest were they connected with ourselves. But oftentimes our personal interest must be subordinated to the interests of other individuals or of the race, and according as a person is or is not able to do this, he is public spirited or generous or, on the other hand, self-centred, selfish, and mean.

Attention and Inattention. Inattention does not mean the entire absence of attention. It means only that we are, at any given moment, "not attentive" to some particular object. We are always relatively, while conscious, in a condition of attention. When another person wishes to attract our attention to an object and fails to do so, he may accuse us of being inattentive, but the truth is that, because he has failed to arouse our interest, we are giving our attention not to him, but to some other object which at that moment interests us more. When the teacher says to the child "Pay attention," the child is probably acutely attentive to a bag of sweets in his pocket or a game which he is going to play when school is over. The habit of inattention has ample and definite advantages, and is worth cultivating. To be able to reject at once from the mind what is not worth *while* is obviously an economical habit, and releases powers for things that really matter.

Three Forms of Attention. The three forms of attention are: (1) Passive or involuntary; (2) active or voluntary; (3) secondary passive.

1. *Passive or Involuntary*—i.e., we attend without any effort on our own part. We cannot help giving our attention—e.g., to a loud noise, a bright light, a violent pain. When our interest is thus spontaneously aroused, it requires a violent effort of the will—and even this may be unsuccessful—to divert our attention from that object. It may even follow us into our sleeping hours, and reappear in the form of dreams and nightmares. In young children and animals

in their natural state all attention is of this kind. With animals (and this applies also largely to human beings) passive attention is essential to their existence. No wild animal would live very long if its attention were not involuntarily attracted by a strange smell—*e.g.*, man or other foe—or an unusual sight—*e.g.*, a trap. The unusual calls forth passive attention when to the usual we might give no attention—*e.g.*, normally we give our teeth no thought, but if they are throbbing painful we find it difficult to attend to anything else.

2. *Active or Voluntary.* In this form the act of attention is the result of definite and deliberate action on our part. We attend to an object or a thought by an effort of the will. Attention is achieved by action within ourselves, and not, as in passive attention, by action from without. This form develops as we pass from infancy—*e.g.*, a child is writing lines as a punishment, and while there is little interest, there is very active attention. A man is plastering a wall; he finds no pleasure in the task, but he attends actively to it. This is an example which is of general application. There are many people who are engaged in occupations which are exceedingly arduous or repulsive, or for some other reason distasteful, yet they find interest in the work and give active attention to it, not because of the pleasure the work itself gives them, but because it is the means whereby they earn a livelihood, and so procure subsistence for themselves and their families. The reason for performing an action, be it pleasure or money, or safety or excitement, or any other thing, is called the *motive* or *incentive*.

3. *Secondary Passive Attention* Oftentimes we begin a task not because we wish, but because we know we ought to do so, and we give to it our active attention. But as the task proceeds we may find that our motive has changed and we are taking pleasure in the task, so that the attention

which before was active is now spontaneous. This form of attention is known as secondary passive attention. It differs from passive attention in that the latter is instinctive, while the former has evolved from a previous state of active attention—*e.g.*, a man begins to study for examination purposes. Up to a point his attention is active, but he becomes so absorbed in the subject that he continues to study it even when the examination is past—*i.e.*, active attention has become secondary passive attention.

Conditions on which Attention Depends. There are some things which arouse our interest and so attract our attention more easily and more quickly than others. This fact is made use of in countless ways in everyday life, in advertising, in journalism (headlines), in teaching, and in public speaking, and in many other ways. A number of rules may be laid down:

1. Intense stimuli arouse attention more easily than less intense—*e.g.*, a loud noise, acute pain, a bright flash.

2. Large objects attract attention sooner than small objects—*e.g.*, a tall man in a crowd; a splash of colour on a wall attracts attention when a spot of the same colour would be unnoticed.

3. Attention depends on duration of stimulus—one tap at my study door may fail to withdraw my attention from my work, but continuous tapping, however quiet, will sooner or later force itself upon my notice. But if the stimulus be too long continued, it ceases to attract attention; passengers on board ship “become accustomed” to the noise of the engines; people living in a street along which the trams run become so used to the noise that they are, for a time, unable to sleep when they move to a house past which trams do not run.

4. A moving object attracts attention more readily than



a stationary object—*e.g.*, a rabbit may be invisible while it is still, but attracts attention immediately it moves.

Duration of Attention. Attention may be either diffused (or distributed) or concentrated. When I lie on my back on a hot day and let my eye wander over the landscape while I muse upon things in general, my attention is diffused. But when I see a bird in a tree, and strain my eyes to discover what kind of bird it is, then my attention becomes more concentrated. Concentration is the deliberate exclusion from the mind of any other interest save that to which we desire to attend. The more attention is concentrated, the shorter the space of time we can give attention to an object. "The longest stretch of attention recorded," says Titchener, "is a stretch of twenty-four seconds, and the average length of attention is no more than five or six seconds." After this time we may think we are concentrating our attention upon the object—*e.g.*, upon the bird in the tree—but in reality our attention is wandering to surrounding objects and thus is diffused. We can give diffused attention for indefinite periods of time in reading a book or looking at a painting or picture, for example, because our attention proceeds from one object to another in a series of rapidly successive leaps. Concentration does not necessarily imply any degree of intensity of attention. We may concentrate more or less idly, or more or less intensely, according to the motive or incentive.

Distribution of Attention. It is sometimes said that it is possible to give attention to only one object at the same time. This, as a general rule, is true. Try, for example, the familiar experiment of drawing circles with one hand and vertical lines simultaneously with the other. But when we become so accustomed to certain actions, or so familiar with certain subjects that we give them secondary passive attention, then we may give attention to several

things at the same time—*e.g.*, after a certain amount of practice it becomes more and more easy to draw circles and lines simultaneously. Or, again, a mother can knit and read and rock the cradle and listen for her husband's foot-step all at the same time. But these are all habitual actions. Where actions are not habitual, we may seem to be attending to more than one at the same moment, but really our attention is flitting from one to the other alternately. A man, *e.g.*, may think that he is writing and smoking at the same time, but the frequency with which he stops to relight his pipe shows that he is smoking only when he thinks about it. The number of objects which may be held in the attention at the same moment is not definitely settled, but is probably not more than four or five. The student may verify this for himself by a few simple experiments.

1. Arrange four miscellaneous articles on a tray and cover them with a cloth. Remove the cloth so that the spectators may see them for a moment (do not give them time to learn the articles), and let them write down the articles to which they have been able to give attention. Repeat the experiment with five and six up to ten, with different articles each time. It will probably be found that the average will not increase beyond five.

2. Make a number of dots arbitrarily on paper thus:  and show them to someone for a moment. He will probably be unable to grasp more than four or five. But arrange the dots in order thus:  and he will be able to grasp a much greater number. The pips upon a playing card and the dots on a domino are arranged in a definite order, with which use has made us so familiar that we can see them all in a glance without the necessity of counting them.

3. Only four or five letters laid out haphazard can be attended to in a single flash, but four or five words can

be attended to in the same space of time—*e.g.*, here are letters laid out haphazard:

A G B L N E A A R S D M

and here are the same letters arranged into words:

BENGAL MADRAS.

This proves that we read, not by letters, but by general impressions, and accounts for the fact that misprints are so frequently overlooked.

The Physical Condition of Attention. “Attention,” says Titchener, “is a psycho-physical phenomenon”—*i.e.*, the body and the mind co-operate in producing a condition of attention. We are all familiar with the fact that the face and the body take up a position of strain when we are trying hard to hear or to see or to understand. This raises a wide question, which may be more appropriately considered in the chapter which follows.

THE DEVELOPMENT OF INTEREST

The Conditions on which Interest Depends. Watch a number of people opening their daily newspaper in the morning, and you will observe that they do not all open it at the same page. If you question them, they will reply, “Oh, yes; I always read that page first.” A woman will read first the fashion page or social engagements, but a man will turn first to the sports page, or the political news, or the financial column. There are some things in the papers which we never read because “they do not interest us.” The fact is, we are all interested in some things, but not all in the same things, and there are many subjects in which other people may be keenly interested which do not awaken the slightest response in us. The editor of the *Medical-*

Review does not expect his paper to circulate widely among farmers, and there are probably very few women who are regular readers of the *Metal Trades' Advertiser*. What is it, then, which determines the things in which we are or are not interested?

Apperception Masses. The ideas which we have consciously in our mind at any given moment are very limited in number, the reason being that, as we have already seen, few people can give attention to more than one idea at one moment, so that the ideas in our conscious mind are those only which are relevant to the occupation in hand. But in addition to these there is a vast wealth of ideas present, subconsciously, in our mind, waiting in readiness to be called by an appropriate stimulus from the subconscious into the conscious mind. We may think of this total wealth of ideas as being arranged in our minds in a series of groups or masses. The name given to these groups or masses is *apperception masses*. A sportsman, for example, has an apperception mass consisting of all his ideas about horses and dogs and rifles and tracking and nature lore and the like; a book collector has an apperception mass consisting of all his knowledge about first editions, printing, binding, and so on. Our interests in life are determined by our apperception masses. We have defined apperception as the conscious perception of a sensory impression—*i.e.*, it is the process by which new knowledge is absorbed and combined with knowledge already in our mind. But if there is no old knowledge with which the new idea can be linked up, there is no response in our mind to the new idea, and we are not interested. If a stranger approaches you and says "My name is Jones," you are probably not interested. If he goes on to say "I knew your brother in India," your interest is at once aroused, because you have linked up Jones with the apperception mass which is con-

cerned with your family relationships. A man whose investments are in a precarious condition will, when his newspaper arrives, turn feverishly, not to the cricket scores, but to the Stock Exchange news, because he desires certain knowledge which will link up readily with his predominant apperception mass. Further, the greater the complexity and the variety within unity of an apperception mass, the greater becomes the degree of interest and the longer becomes the time during which an object can hold our attention, because our mind can pass in succession from one aspect of the idea to another. Of two men in a picture gallery, one looks at each picture, but passes rapidly from one to the other, because he "knows what he likes," but knows little else about art. The other man will stand for a long time before each picture. He places it in its period, he compares it mentally with the work of contemporary and of modern painters, he considers the colouring, the technique, the composition. We are now in a position to understand why some people are "interesting" and others "dull." Some people who to me are extremely interesting may by others be considered very dull, and *vice versa*. Speaking particularly from a personal point of view, people are interesting or dull according to whether their apperception masses do or do not correspond to mine. An elderly numismatist is always talking about his own subject, and I consider him a very dull person, because I have no knowledge of coins to which I can link his conversation. But watch him talking to a brother numismatist, and it becomes evident that they find each other exceedingly interesting people. More generally speaking, an interesting person is he or she who has a wide variety of interests, and who is familiar with an extensive range of thought and idea. This is a point of great importance to all who are concerned with the science of education. Life consists not

in eating and drinking and sleeping, for the lower animals do this in common with man, but in the number and variety of our points of contact—that is, in the increase in quantity and quality of our apperception masses. The old idea of education was that its aim was the amassing of knowledge for its own sake; the new idea is that the aim of education is the creation of interests. Interest is no longer regarded merely as a means to an end, but as an end in itself. This change has effected a revolution in methods of teaching. We do not now, by various devices, seek to interest the children in order that they may be induced to acquire a store of knowledge; we increase their knowledge in order that we may increase their range of interests. Interest, which was formerly a tool to obtain an educational result, has now become itself the desired result. This change has come about largely through the teaching of Johann Friedrich Herbart (1776-1841), a German educationist, who taught that the ideal to be aimed at in education was to produce a person equipped with many interests, “one who finds nothing in the world alien to him.” The same truth has been expressed in other words: “An educated man is one who knows something of everything and everything of something.”

Interest and Secondary Passive Attention. In the last chapter the three forms of attention were considered, and we saw that secondary passive attention is that which evolves from a previous state of active attention. The effort involved in active attention is, like all other effort, fatiguing. It is obviously an advantage when the attention is effortless, as it increasingly becomes when we are so interested in a subject that we can give to it the secondary passive form of attention. “Secondary passive attention,” says Titchener, “is the chief condition of human progress. The more a piece of work is reduced to a matter of

course, the more power has the mind to advance to further work. This becomes natural and easy in its turn, and gives place to new work, and so on. . . . Active attention thus appears as a stage of waste, a stage to be got rid of. At the same time, it is a stage which must be passed through, and passed through again and again, if knowledge is to grow and character to be rightly moulded. The child who did not pass through it would remain at the level of the animals. . . . Active attention is the battle which must be won by those who mean to master their surroundings and rise to man's full height above the animal world." This can be achieved by forming powerful apperception masses in the mind of a child, and so increasing his interest in life that there may be a large number of links to unite the new with the old. The contrary process may also take place. Certain apperception masses may remain so long unused and undisturbed in the subconscious mind that they become atrophied through lack of exercise, and one's interests are thereby diminished to the impoverishment of life. There is a passage in Charles Darwin's Autobiography which has a bearing on this point. After speaking of the great pleasure and delight which up to the age of thirty he found in poetry, music, and pictures, he proceeds: "But now for many years I cannot endure to read a line of poetry. I have tried lately to read Shakespeare, and found it so intolerably dull that it nauseated me. I have also almost lost my taste for pictures and music. . . . If I had my life again I would have made (*sic*) a rule to read some poetry and listen to some music at least once every week; for perhaps the parts of my brain now atrophied would have been (*sic*) thus kept alive through use. The loss of these tastes is a loss of happiness, and may possibly be injurious to the intellect, and more probably to the moral character by enfeebling the emotional part of our nature."

Manner is as Essential as Matter in the Creation of Interest.

Books on the same subject vary in interest according to the manner in which the books are written; a profound scholar may fail as a teacher because he is a dull lecturer; a good play often fails because, when produced, it is badly acted. This is a matter of deep concern to the teacher, the preacher, and all who in any way have to influence or instruct others. The only instrument by which we can express thought and emotion is the body, and the study of the production of the voice, the expression of the face, the movement of the body in gesture, should be regarded as essential by all who are called upon from time to time to arouse the interest of an audience.

Interest and Bodily Attitude. Sometimes when a person begins to take interest in something which is happening around him, not because he ought, but because he desires to do so, we say that "he is sitting up and taking notice." Those who use this idiom are often unconscious of the fact that they are expressing a profound psychological truth. At the end of the last chapter we quoted Titchener's remark that "attention is a psycho-physical phenomenon"—*i.e.*, the body and the mind co-operate in producing a condition of attention. There are three bodily changes which usually accompany attention, and the greater the interest with which we attend, the more marked as a rule are the bodily changes. Listen intently to a particular noise in the street outside, and two, at any rate, of the following three bodily changes will become manifest:

1. *Respiratory.* The breathing is checked, or it ceases altogether. (Note the familiar phrase "breathless attention.")

2. *Motor.* The muscles are braced up, the body is tense, and the head held firmly in a certain position, straight-forward if the object is a sight, sideways if it is a sound.

3. *Vasomotor.* The heart beats more strongly and quickly, and there is a quickening of the flow of the blood in the bloodvessels.

When we are interested in any subject we assume, unconsciously, a certain bodily attitude. Conversely, by placing ourselves consciously in an appropriate bodily attitude, we become as a rule more readily interested in a subject. Further, we cannot expect to arouse the interest of a class of children, or command the attention of an audience if they are permitted to retain an inappropriate bodily attitude. For example, we cannot do acute mental work whilst reclining lazily in an armchair; if we seek to reprimand or exhort with our elbows resting on the arms of our chair, and with the hands hanging downward from the wrist, our reprimand or exhortation will be very ineffectual, but if we say the same words with the hands braced up and palms upward, our words become at once more effective. Dr. Thring, a famous English headmaster, once said that if you permit a boy to maintain an inattentive attitude nothing will make him attentive.

The Aim of the Development of Interest. We have seen that, according to the philosophy of Herbart, the aim of education is the development of a great variety of interests by the creation of apperception masses. But Herbart goes further, as indeed we all must, if our educational ideas are to be of practical value. Interests are of little worth so long as they remain only interests. The value of our interests can only be judged by our outward expression of them. Our aim, therefore, must go beyond the mere development of interests and lead on to their expression, so that children may, in due course, take their rightful place in the family, the society, the nation. Only in so far as interests are expressed in service does a man justify his existence and fulfil his function in the world.

THE WILL

Psychology is not yet, and probably never will become, one of the exact sciences, for it is not at all likely that instincts, emotions, interest, apperception masses, and the like will ever be capable of exact measurement. There will always be within this science a wide range of diverse opinion and point of view. Nowhere is this divergence more marked than in the writings of psychologists on the subject of this present chapter, for of all the branches of the science of psychology, that which is concerned with the psychology of the will is the most obscure. There is no generally agreed and recognised definition of will, and the varying definitions lead to varying treatment of the subject.

Will and Volition. Some psychologists use these terms as though they were strictly synonymous, but the distinction between them may be seen by considering two definitions of "will":

1. Will is that part of the mental process which is concerned with the choosing of one of a number of possible actions.

2. Will is the conscious direction of activities towards the attainment of a desired object.

In the first of these definitions, will is thought of as static—the act of choosing; in the second, will is dynamic—will is "a direction of activities." But the term volition might be kept for this direction of activities. In other words, then, will is the power, and volition is the power in active employment; the exercise of the will results in a great number of acts of volition. These acts of volition include not only physical acts, but also mental—*e.g.*, the will to believe, to be cheerful, to be hopeful. They may also include the "act of doing nothing." When a board of

directors resolve that "no action be taken," or when we bask in the sunshine "doing nothing," they and we are making a very definite act of the will. "To do nothing" may be a very deliberate choice of "one of a number of possible actions."

"Attention" and "will" are also sometimes used as synonymous terms, on the ground that a choice of action can only be made by giving attention to each of the possibilities in turn. On the other hand, it is argued that will is the dominant factor, and the first in point of time, because it requires an act of will to bring attention to bear upon the possible choices, so that attention is regarded as a form of volition. McDougall calls attention to "the fundamental act of the will."

The Place of the Will in Human Personality. In speaking of the will in everyday life, people often fall into the error, almost of hypostatisation, of speaking of the will as though it possessed a separate independent existence; as though it were the controller of all the other faculties; as though it were not I who speak, or think, or do, but the will which directs me as to what I shall say, or think, or do. Sir John Adams illustrates this popular idea by the suggestion of the psyche as a court of justice in which the will presides as the judge, and the motives appear one by one and, urging their claims, plead for a decision in their favour against contending motives. But this, as Adams points out, is quite an erroneous idea. The will is not a kind of internal spirit which makes up our mind for us and tells us what to do. We say, "Shall I do this or that?" and our will does not control us, but we control the will. There is no will as a separate entity any more than imagination or memory may be regarded as separate entities. "Will is not a faculty distinct from the rest of our personality. Will is character in action" (McDougall). "Will is only the name

of the psyche in its conative aspect, as it may be named the mind when we deal with it in its cognitive aspect " (Adams).

Motives and their Influence on Volition. Motives are not forces seeking to impose themselves upon the will, as in our illustration above. They are the calling up in our minds of the advantages and disadvantages of the possible lines of conduct. We speak of strong or weak motives, but no motive is strong or weak *per se*. It is only strong or weak as it is thought upon in the light of the totality of a situation; it derives its strength or weakness from the probable results of a possible course of action. For example, I have promised to go and spend the evening with the Robinsons, friends at the other end of the town, and I am undecided as to what to do. The motives for not going are to obtain pleasure by sitting by the fireside reading; to avoid the displeasure of going out in the rain and of suffering from the cold I may catch; to avoid the displeasure of becoming more closely acquainted with people I do not really want to know. The motives for going are to give the Robinsons a certain amount of pleasure; to prevent the uneasiness of conscience which will assuredly be mine if I break my promise. No one of these motives is, *per se*, weaker or stronger than another. It is I myself who, in the light of my knowledge of a complex situation, decide the strength or weakness of each motive. It will be noticed that the strength or weakness of a motive is always expressed in terms of the pain or pleasure which will most probably result from the action prompted by that motive. A motive is always a desire or an instinct.

Deliberation is the state of mind while the motives are being considered and weighed one against the other. In more homely language it is just "thinking the matter over." Deliberation, in some measure, is necessary when there is a complexity of unequal motives, or when there is an ever

balance of motives and none is pressingly urgent. It is generally agreed that deliberate action as a rule is safest, that we should "look before we leap," that we should not "jump to conclusions." The people who jump—or appear to jump—hastily to conclusions do so either because they possess the quality of intuition or lack the quality of caution. *Intuition* is the power of arriving in a flash at a conclusion which others can only reach by a process of deliberation. It is a quality to be desired, if only it is remembered that a person can be intuitively wrong as well as intuitively right. Caution (which is derived from the Latin *cautio*, I take heed) is the realisation of the danger of hasty decision. It is a quality of which some people possess too much, others too little. It must not be confused with hesitation or with procrastination. When we hesitate, we are reluctant to make up our mind; we flit from one motive to another without extracting the full possibilities from any; we return to the consideration of motives which we have already discarded. "He who hesitates is lost," runs the proverb, for the opportunity to act may be lost while he is making up his mind. But procrastination (Latin *crastinus*, relating to tomorrow) means that, having weighed the motives and come to a decision, we shrink from putting the decision into effect; we put off till tomorrow what we might just as well do today. There are occasions when most of us find that we are unable to make up our minds—*e.g.*, one man can never decide which way to vote at a meeting until it becomes obvious which side is in the majority; or a woman wishing to buy a hat may look at forty hats, and then be unable to make a choice of one of them. But sometimes we find people in whom the inability to make an act of will has become a permanent condition, in which the will seems to have become completely paralysed. This is a mental disease which is known as *abulia*.

Will and Character. Actions may be classified as (a) involuntary (or instinctive), (b) voluntary (or purposive). Instinctive actions do not come within the limits of the subject of this chapter, for they are the result of reflex responses to physical stimuli, applied to the various sense organs. "Spontaneous reflex and instinctive actions, even when accompanied by a mental element—sensation or feeling—can be traced solely to certain organic conditions, and do not proceed from a mental initiative" (Woodworth)—that is, they do not begin in the mind. But purposive or voluntary acts are the outcome of a mental process issuing in an act of the will. The development of habits, of self-control, in a word, of character, proceeds, *pari passu*, with the development and control of the will. As Woodworth expresses it: "Every decision made, every conflict resolved, is a step in the further organisation of the individual. It may be a step in a good or a bad direction, but it is a step in organising the individual reaction tendencies into what we call his character." "A man's character," it has been said, "is nothing more nor less than his will in action."

Potential and Final Choice. *Potential choice* is that which would result, if no other motives entered, from a man's character, temperament, personal likes and dislikes, etc. But only rarely do we find people acting from motives which are entirely personal and internal. There are other motives which should be considered—motives external to ourselves—e.g., family, social, humanitarian considerations, and so on. *Final choice* is that which results when *all* motives, internal and external, have been considered. There are some people in whom the margin between potential and final choice is very wide; there are others in whom the margin is more or less narrow until, in some, potential and final choice equate. It is largely a question of personal character. The man who makes up his mind and "sticks

to it " is generally called a man of strong will. But when a man's mind, through fear or selfishness, is impervious to appeals of reason, or sympathy, or to differing opinions and points of view, it is a sign not of his strength of will, but of its weakness. He would be more truly described not as strong willed, but as stubborn. The man who is really strong willed is he who is quite willing to alter his choice of action when adequate reason is shown to him. As steel is stronger than iron because of its power of bending when need be, so a man of flexible will is a stronger-willed man than he whose will is rigid.

The Freedom of the Will. Although the question of the freedom of the will is essentially a matter for the philosopher rather than the psychologist, yet a chapter on the will would be incomplete without some reference to it. The subject has been discussed by philosophers since the dawn of history, and the discussion has been nebulous because there has been no general agreement upon the limits of the subject or upon a definition of the terms.

The question to be settled is that of determinism against the freedom of the will. The determinist position is that the law of causality (*i.e.*, every event, everything which comes to pass, must have a cause) is of universal application; that our character and our acts are controlled by forces which work as uniformly as those which determine the motions of the heavenly bodies or the growth of plants. Our will, the determinist holds, is as determined as anything in the inorganic world. As there are many events which happen in the universe which we have not yet sufficient knowledge to explain, but which we yet believe to be the effect of the working of natural law which is yet unrevealed, so we have not yet sufficient knowledge of the manifold factors which determine our will, but there can be no doubt that there is no event in the mental and spiritual life which does

not obey immutable laws. Those who, on the other hand, accept the doctrine of the freedom of the will, insist that the will is free to make a conscious choice when there is the possibility of a number of courses of action. But freedom must not be understood to mean that unhampered and unlimited freedom which is not truly freedom, but which would result in general chaos. They assert that the will is free within certain freely accepted limits. If a man willingly accepts the limits imposed by conscience, by law, by social convention, and so on, his will is essentially no less free than that of a man who chooses to disregard these limits. So, it is asserted, human decisions really are as free as we feel that they are; they are real determinants which have themselves the power to begin a new sequence of cause and effect; we are right in believing that when we have done *this* we might have done *that* had we so willed; the sense of responsibility which we feel for our own actions is not a delusion, neither is that sense of power which we all feel—the sense of our ability to mould events, and so to be, to a certain extent, “the master of our fate.”

It is obviously impossible, within our brief limits, to discuss at any length the pros and cons of the determinist or the free will doctrine. The strength of the determinist argument was greatly increased by the scientific discoveries of the last two centuries. The conception of natural laws invariable in their operation was found to be apparently trustworthy within limited regions of nature. From the consequent generalisation that the universe could be explained in terms of invariable sequence man was not excluded.

The determinist doctrine depends upon the law of causality. If the law goes, the doctrine goes with it. As far as Western philosophy is concerned, the question between free will and determinism is no longer an open one, but has become of merely academic interest. A catena of

quotations from the writings of modern philosophers might be given, but one will suffice. Even when this chapter was written (November, 1930), Sir Arthur Eddington, Professor of Astronomy in the University of Cambridge, broadcast a lecture in which he used these words: "Another striking change of scientific views is in regard to determinism. . . . Until recently this was almost universally accepted as the teaching of science—at least, in regard to the material universe. . . . But today physical science is built on a foundation which knows nothing of this supposed determinism. So far as we have gone in our probing of the universe, we cannot find a particle of evidence in favour of determinism. . . . There is no longer any need to doubt our intuition of free will. Our minds are not merely registering a predetermined sequence of thoughts and decisions. Our purpose, our volitions, are genuine; and ours is the responsibility for what ensues from them. For we are scarcely likely to accept a theory which would make the human spirit more mechanistic than the physical universe."

BIBLIOGRAPHY

- DRUMMOND, W. B. Elementary Physiology.
- HOWELL, WILLIAM H. A Text-Book of Physiology.
- ROBERTS, FRANKCON. Synopsis of Physiology.
- STARLING, ERNEST H. Elements of Human Physiology.
- CUNNINGHAM, D. J. Manual of Practical Anatomy.
- GRAY, HENRY. Gray's Anatomy—Descriptive and Applied.
- MASSIE, GRANT. Surgical Anatomy.
- BANKS, CHARLES. Manual of Hygiene and Domestic Economy.
- O'SHEA AND KELLOG. Health Series of Physiology and Hygiene.
- SHAW, EDWARD R. School Hygiene.
- WATSON AND WELPLY. The Medical Signpost and Directory of the London Health Services.
- ADAMS, SIR JOHN. Everyman's Psychology.
- ADAMS, SIR JOHN. The Herbartian Psychology applied to Education.
- DUMVILLE, BENJAMIN. Child Mind.
- HARFORD, CHARLES F. Mind as a Force.
- MCDUGALL, WILLIAM. An Outline of Psychology.
- MEREDITH, CHRISTABEL M. Modern Psychology.
- NISBET, J. F. The Insanity of Genius.
- SADLER, WILLIAM S. The Mind at Mischief.
- TITCHENER, E. B. A Primer of Psychology.
- WOODWORTH, ROBERT S. Psychology: A Study of Mental Life.
- BASTEDO, WALTER A. Materia Medica, Pharmacology and Therapeutics.
- MONRO, THOMAS KIRKPATRICK. Manual of Medicine.
- OSLER, SIR WILLIAM. The Principles and Practice of Medicine.
- CHAMBERS. The Illustrated Chambers's Encyclopædia.
- CHAMBERS. Twentieth Century Dictionary.

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